The Welding Engineer

Reg. U. S. Pat. Office

Founded by L. B. Mackenzie, 1916

AUGUST, 1928 VOL. 13, NO. 8

$3.00 per year in U. S. 608 S. Dearborn St., Chicago, Ill. $4.00 per year abroad

"Ordinary Wire Required Eighteen Hours— Quasi-Arc Did a BETTER Job in Eleven"

This is from a report on the welding of boiler tubes in the plant of one of our customers. It is not unusual for Quasi-Arc, but it illustrates why Quasi-Arc Electrodes are the most economical, though highest priced, welding rods on the market. But, just as important as their economy, is the unequalled quality, reliability and uniformity of the welds they produce.

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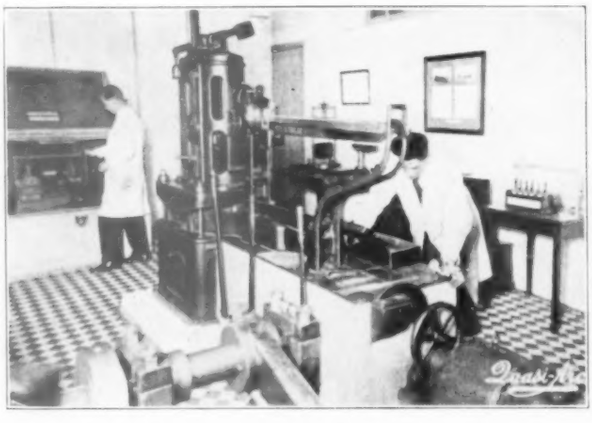

Views of our Research and Testing Laboratories—an important feature of QUASI-ARC Service

QUASI-ARC INCORPORATED

Sole Manufacturers of Quasi-Arc Electrodes and Welding Equipments and Consultants in Reference to their Application

11 WEST 42nd STREET, NEW YORK, N. Y.

HARRISBURG CHICAGO CLEVELAND

Published monthly by the Welding Engineer Publishing Co. Entered as second class matter Jan. 20, 1916, at the Post Office at Chicago, Ill., under the Act of March 3, 1879.

NW

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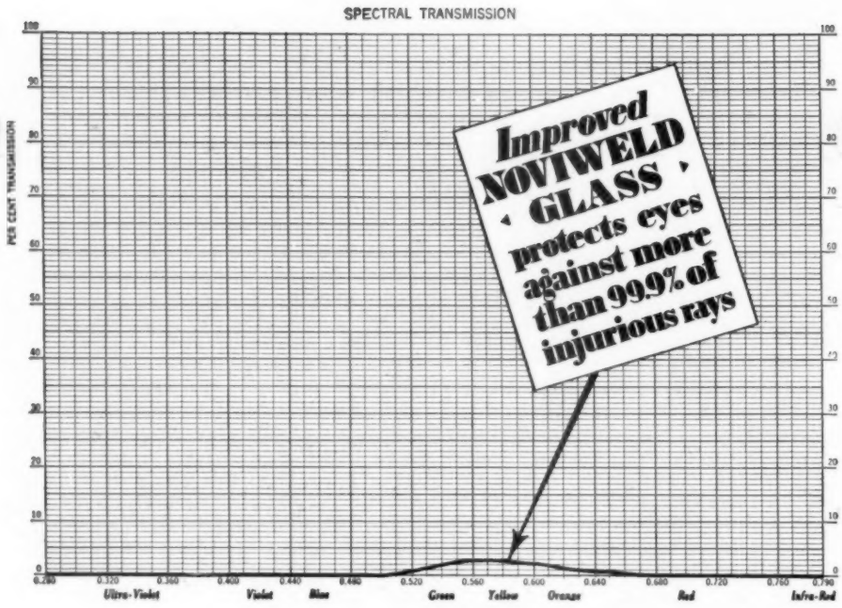

No. 6 shade Noviweld, from which this curve is taken, is the lightest we recommend for welding.

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FOR WELDERS' HELMETS AND GOGGLES

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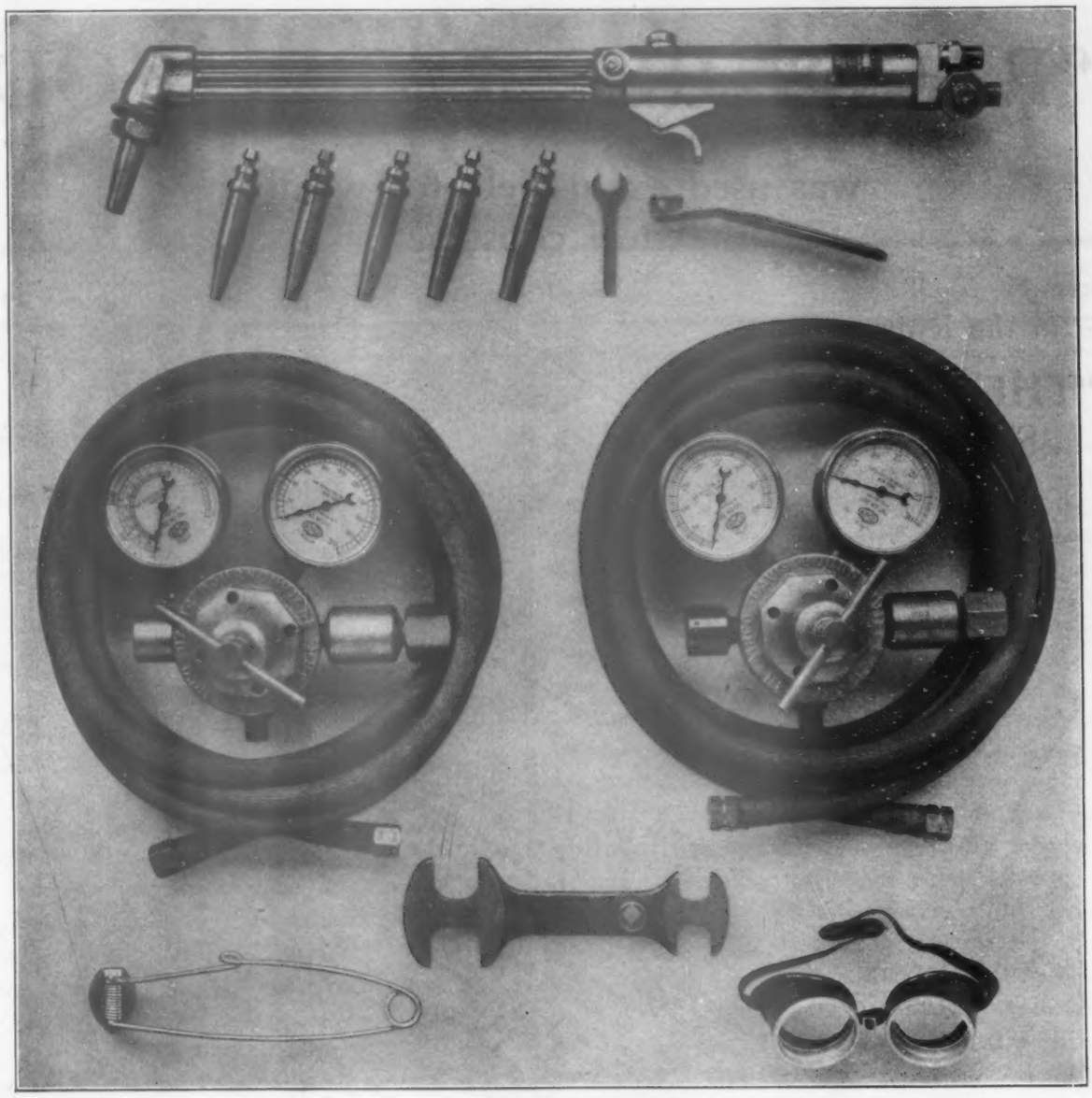

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New Style 8200 and 8202 Pressure Regulators, with 2½ in. gauges

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was used exclusively for welding the steel construction

in the Ryan plane

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SAN DIEGO, CALIFORNIA
FEBRUARY 15 1928
Reid-Avery Company,
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Philadelphia, Pa.
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Subject: Red Label Welding Rod.
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This rod was used exclusively for welding the steel construction in the Ryan plane "The Spirit of St. Louis" which we built for Colonel Lindbergh, and in which he has since flown many thousands of miles with no report of failure in any welded joint.
We take pleasure in stating that your rod has been checked against a number of different makes and has proved to be the best suited for the particular kind of work which we are doing.
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B. F. MAHONEY AIRCRAFT CORPORATION
(Owners of Ryan Airlines)
Walter O. Locke
Walter O. Locke
Production Engineer
WOL:C

Manufacturers of

OXY-ACETYLENE WELDING RODS

ELECTRIC WELDING RODS

"RACO" COMPOSITE WIRE FOR AUTOMATIC ELECTRIC ARC WELDING

America's Standard

REID-AVERY CO., *Inc.*, PHILADELPHIA

The Welding Engineer

Founded by L. B. Mackenzie, 1916

Volume 13 August 1928 Number 8

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Tell the Other Fellow

NOT all of the progress in welding methods comes from the laboratories of the welding equipment manufacturers nor from the various engineering societies, as great as is their contribution to the improvement of the art. In the research departments of the users of one or more of the welding processes new methods and procedures are constantly being developed which, for those individual plants, eliminate obstacles which once had hindered the use or the full efficiency of welding. When a production department decides that welding could be used to advantage in fabrication of the product, it will always pay to put to work every facility to find the methods and materials best adapted to joining by fusion to give the desired result. The fact that a certain job has never been done by welding does not mean that it never will be done. The research-minded engineer finds a way, and an addition to welding knowledge results. The greatest progress by each and all can be made, however, only when there is full and free exchange of ideas and discoveries evolving from this research.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
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SUCCESSFUL arc-welding demands the RIGHT wire for the *particular* metal which is to be welded. For instance, steel requires one analysis of wire; machineable welds on cast-iron another; and bronze, still another. And again, the purpose of the weld further determines the analysis required. Boiler work, where tensile strength is the vital factor, requires one analysis of wire; and rail heads, where hardness is of first importance, requires another analysis.

Wilson has developed a correct Grade (analysis) of wire for practically every welding purpose—each designated by a color, hence *"Color-tipt."* And every Grade of Wilson is *uniform throughout.*

Above: One of several arc-welded stacks at the Edison Plant, 14th Street and East River, New York, on which Wilson Grade No. 17 (patented U. S. A., June 13, 1916; March 9, 1920) was used. Each stack is 256 feet high and 22½ feet in diameter, and contains 7000 feet (1½ miles) of arc-welding.

Above: Showing the Ohio Bell Telephone Building, Cleveland, and welder at work on one of the 16-inch Steam Risers that feed fifteen stories of the building. After exhaustive laboratory tests, Wilson Wire was chosen for every weld on this job. Wilson Grade No. 6 (patented U. S. A., June 13, 1916; March 9, 1920; Canada, March 19, 1918) and Wilson Grade No. 9 (Pat. U. S. A., June 13, 1916; March 9, 1920) were used.

Above: In the Fletcher Shipyard, Hoboken, N. J., welding a cast steel Contra-Propeller to a rudder post with Wilson Grade No. 17.

Left: One of the battery of Vacuum Reservoirs, welded with Wilson Grade No. 6 by G. D. Peters & Co., Ltd., Slough, England.

Right: Showing part of a Steel Structure which was welded with Wilson Wire. Grade No. 17 Bare Wire was used on this job.

Learn for yourself the superiority of Wilson Wire. Tell us the kind of welding you want to do, and we will send you a sample of the correct Grade.

WILSON WELDER & METALS CO. INC., 20 WILSON BUILDING, HOBOKEN, N. J.

See our Exhibit NATIONAL METAL EXPOSITION *Philadelphia* October 8—12

WILSON

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See our Exhibit NATIONAL METAL EXPOSITION *Philadelphia* October 8—12

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GOGGLES
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Shoot-a-Lite Corporation.
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Bissett Steel Co.
SPOT WELDERS
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Modern Engineering Co.
National Carbon Co.
WELDING ROD HOLDERS
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we prove it before we ship it

Our complete stocks of selected rods, wires and electrodes enable us to supply material that has proven to be the best for your job, no matter what kind of a job it is. All of these materials have stood two severe tests, one in our laboratory and another in the customer's service.

SWEDOX

WELDING RODS, WIRES and ELECTRODES

Have been developed through research which started when welding started. It has all been aimed at finding the correct filler material for each individual welding requirement. Along with this proving quality you can be assured of exceptional service, because our three warehouses carry sufficient stocks to make immediate shipments on all grades.

WELDING CARBONS

We have recently become distributors of the products of

NATIONAL CARBON CO., INC.
Cleveland, Ohio

Our stock of National Welding Carbon Products is complete and includes Carbon Plates, Rods, Paste, Welding Electrodes and Graphite Electrodes.

Place an order for SWEDOX and see how satisfactory it is to get real tested quality backed by intelligent and experienced service.

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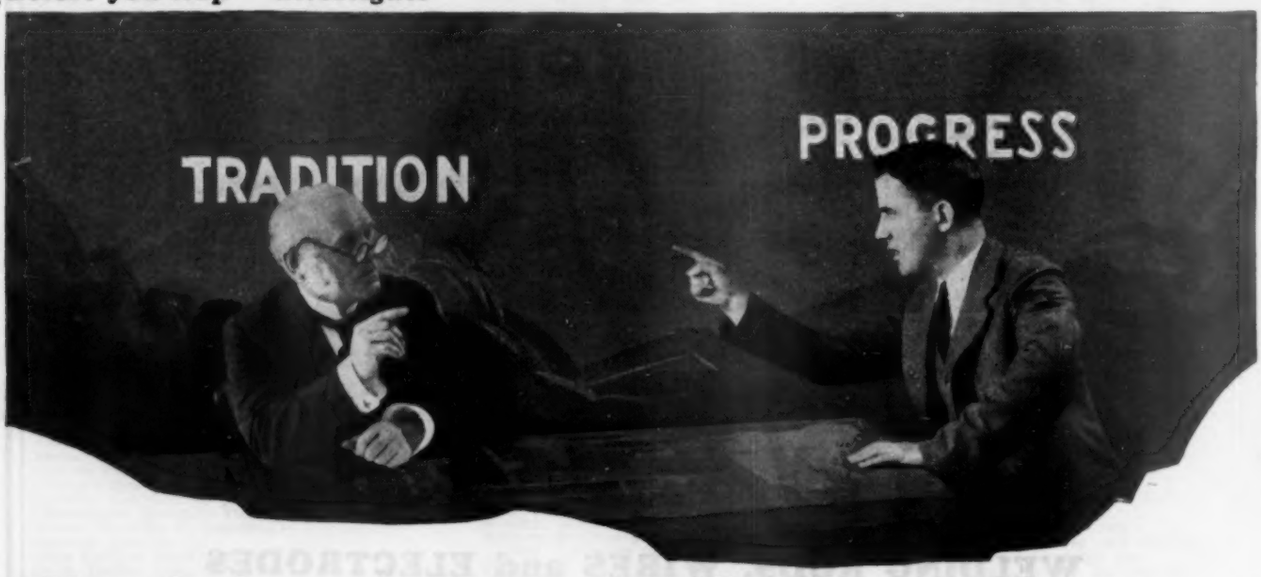
A complete stock of all welding accessories, including goggles, helmets, shields, gloves, electrode holders, lenses, etc., is carried in each of our three warehouses. Include whatever accessories you need in your next order.

Main Warehouses and General Offices, Central Steel & Wire Co., Chicago

Before you leap—investigate



"Here, Lad—

I'm for arc welding all right, but what puzzles me is how to apply it.

I think we ought to look a little before we leap."

"Yes, Pop—

but if you look only a little, you're apt to learn only a little.

You're apt to get into the company of some of your old buddies in the non-specialty electrical business—and they'll sell you arc welding all right

—but it will be from the viewpoint of the *jack-of-all-trades.*

Welding, like insulin, salvarsan, vaccine, etc., was not developed by the general practitioner, but by the specialist, and the application is the specialist's job—but, more important, the machine itself is where you must look long and steadfast. As in all scientific development, that is where the specialist puts in the finesse that the non-specialist doesn't even understand.

And if you look first into the machine you won't have to leap—you just slide peacefully into the best welding practice.

Arc welding isn't a whole lot different from matrimony: A wonderful state with a *helpmeet* (a good welding machine)—but oh! what a state with a stalemate."

Only "Stable-Arc" Welders have all these features

Variable Voltage.
Laminated Magnetic Circuit.
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Double Control of Welding Heat.
Steady Arc Throughout Entire Welding Range.
All Steel Construction.
Full Capacity for either Metallic or Carbon Arc Welding.

These features make welding easier. Results—better welds and greater output.

Ask any Operator!

The Lincoln Electric Co., Dept. No. 27-8, Cleveland, Ohio

W-61

LINCOLN "Stable Arc" WELDER

Listed as standard by the Underwriters' Laboratories, Inc.

A simple little generator* with a fine record of performance

YEARS of service have proved the value of the Carbic Acetylene Generator for welding and cutting. You'll find enthusiastic users in every branch of industry. Thousands of these truly portable generators are in operation all over the country.

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The cost of a Carbic Generator is small and it is extremely economical to operate.

Send for our new catalogue.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation
New York City, 30 East 42d St. UCC Chicago, Peoples Gas Bldg.
San Francisco, Adam Grant Bldg.

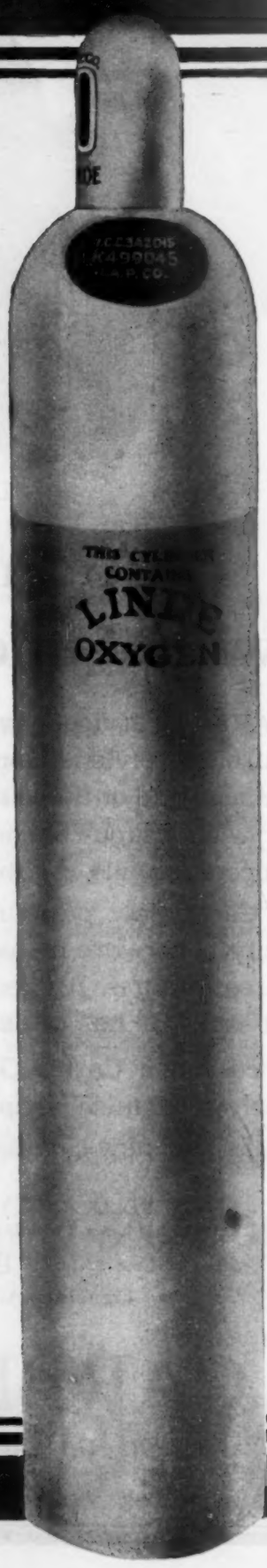
A standard drum of Carbic contains forty cakes, size No. 20. Carbic is distributed by the Union Carbide Sales Company through its national chain of warehouses.

CARBIC GENERATOR

For Oxy-Acetylene Welding and Cutting

**Anyone having a Carbic Generator is entitled to Oxweld Generator Service. Phone or write the nearest district office.*

For Linde customers *only*



AS a user of Linde Oxygen you get a product of uniform high quality and prompt delivery service. ***But are you making full use of Linde Process Service?***

Linde Process Service is always ready to help you with any welding or cutting problem. It will show you how to get the best results in the most economical way.

As a Linde customer you are entitled to this Process Service. It isn't in the written contract but it is yours for the asking.

THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

General Offices: Carbide and Carbon Building
30 East 42d Street, New York

50 PLANTS . . . . . 102 WAREHOUSES

LINDE OXYGEN

Can we supply Prest-O-Lite DISSOLVED ACETYLENE to Palm City, Alaska?

No, not yet, but only because there is no such place. Wherever there is oxy-acetylene welding or cutting work to be done, Prest-O-Lite can be supplied. It is readily available to every part of every state in the union.

33 plants located in the most important industrial centers produce and distribute Prest-O-Lite. In addition, a national chain of 101 warehouses supplies Prest-O-Lite to even the smallest dots on the map.

No matter where you are, Prest-O-Lite is near at hand.

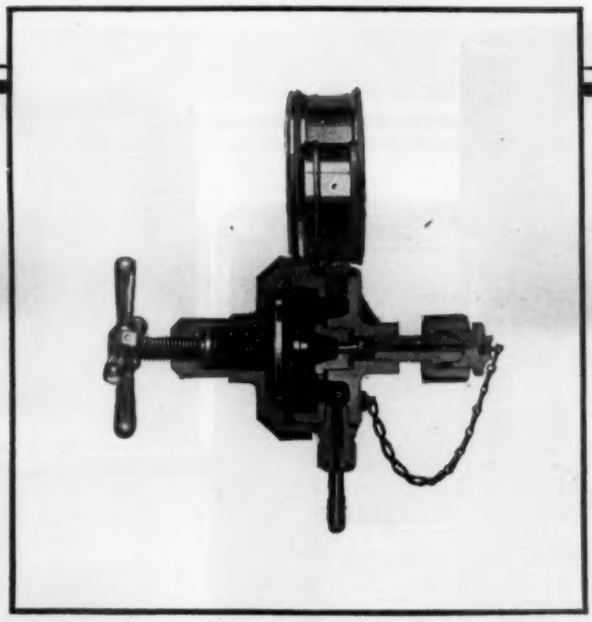
THE PREST-O-LITE COMPANY, INC.

Unit of Union Carbide UCC *and Carbon Corporation*

General Offices: Carbide and Carbon Building

30 East 42d St., New York

33 Plants—101 Warehouses



The Oxweld R-27 regulator is not a nozzle type regulator. For this reason it has exceptional flow capacity and will function properly without freezing.

Stop Playing Jackstraws *with regulator parts*

A LARGE steel company employed two men to keep their several hundred pieces of oxy-acetylene equipment in repair. Recently they standardized on the Oxweld R-27 regulator. Now one man alone is able to handle what repair work is necessary.

Why?

Because the Oxweld R-27 regulator contains only 23 parts. It does the same work older regulators did with thirty-three or more parts. In fact it does it better. Any mechanic can remove all the R-27 parts—make a thorough inspection, replacing a worn valve seat, if necessary—and reassemble—all within a very few minutes and without special tools.

This unusual simplicity in design saves hours of repair time for more productive work, and is an important factor in the most economical operation of oxy-acetylene equipment.

Oxweld
WELDING AND CUTTING APPARATUS

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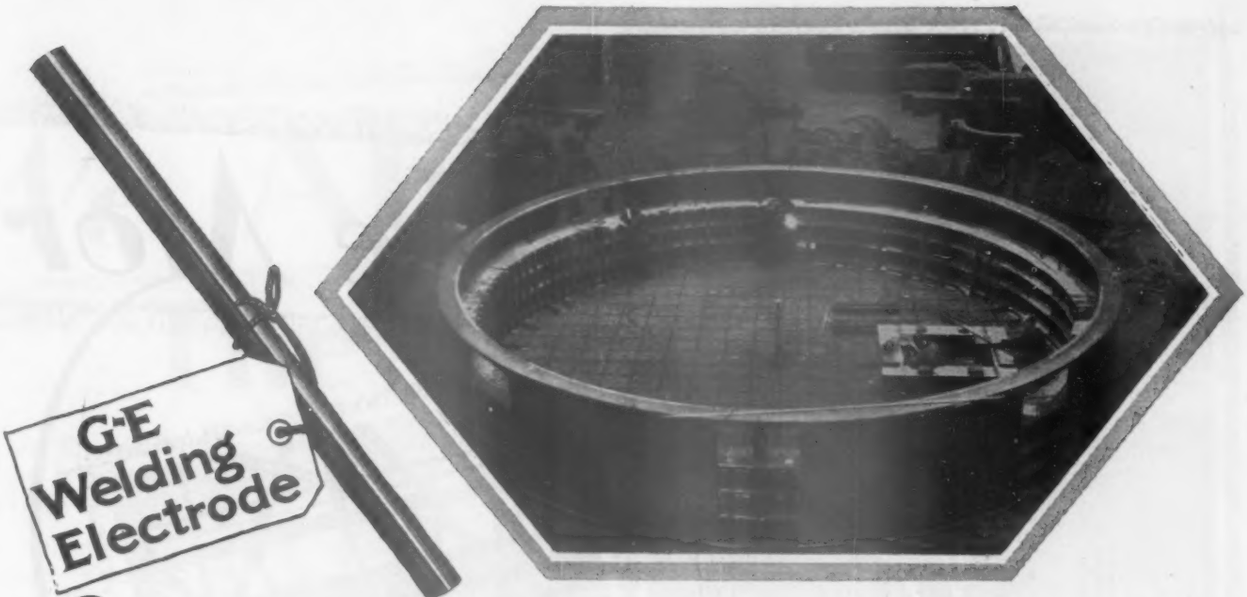


for unfailing service

This giant generator frame is a part of the Conowingo water-power development. It will be subjected to severe, continuous, and long operation. Arc welding has prepared it for unfailing service—arc welding and G-E welding electrode.

More and more, fabricators of iron and steel are turning to arc welding. This new, improved method of construction necessitates electrodes which assure sound, tough unions. You need not worry about welds of uncertain quality when any of these tried and tested G-E welding electrodes are employed:

Type "F" is used for the general welding of steel.
Type "B" is best for automatic welding.
Type "A" is recommended for cast iron.

Special distributors for G-E welding electrodes, located throughout the country, are equipped to give you prompt service. Get in touch with the G-E Welding Electrode Distributor near you or write to the Merchandise Department, General Electric Company, Bridgeport, Connecticut.

550-208

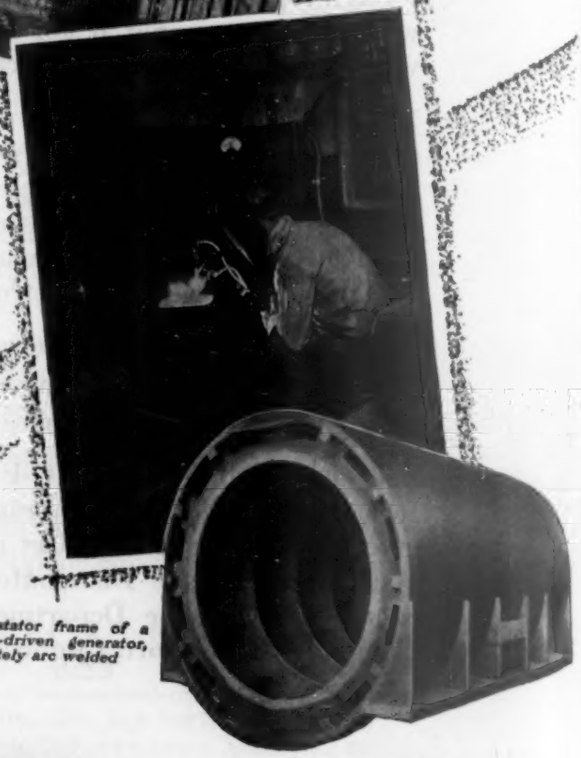
GENERAL ELECTRIC

MERCHANDISE DEPARTMENT, BRIDGEPORT, CONNECTICUT

One of twelve 25,000-kv-a. power transformers completely arc welded for a single order. Each transformer stands 27 feet, 4 inches high and required 592 lineal feet of arc welding

The More

One of the new all-welded factory buildings at the G-E West Philadelphia plant. 1000 tons of structural steel noiselessly welded by the electric arc —a striking example of the trend in building construction



Arc welding the icing unit of the G-E electric refrigerator with the exclusive G-E atomic hydrogen process

Huge stator frame of a turbine-driven generator, completely arc welded

THE MORE YOU ARC WELD

THE MORE YOU SAVE

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

We ARC WELD—

The More We Save!

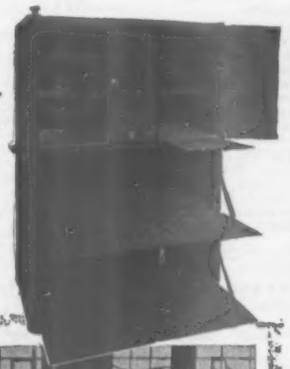
General Electric is the world's largest user of arc welding and is constantly discovering new applications for it both as a production tool and as a repair tool.

Arc welding has made G-E equipment lighter yet stronger—simpler, more enduring, and more attractive. It has eliminated costly manufacturing processes all along the line from drafting room to finished products. And it has materially decreased the outlay for manufacturing tools.

Nothing "will-o'-the-wisp" about these savings! They are impressive and they have enabled General Electric to improve its products continually and to reduce its prices substantially.

Arc welding has reached the point where it demands your immediate attention. It is radically changing manufacturing methods. Be the first in your field to use it—and reap the rewards of the successful pioneer. Your nearest G-E office will give you valuable help in applying arc welding in your plant.

Arc welding is also one of the most important repair tools used in G-E Service Shops. The use of this modern tool has been largely responsible for the fast, low-cost, and superior repair jobs which are a tradition with all G-E Service Shops.



One of hundreds of pieces of factory equipment fabricated by the electric arc

All-welded steel chair for factory operator. Much of G-E factory furniture is arc welded

Two-head automatic arc welding machine welding a 14-ft. stator frame

Welding the stator frame of a 40,000-kw. generator for the Conowingo Power Development. The frame is 37 feet in diameter, and all circular seams are automatically welded

530-41

ELECTRIC

SALES OFFICES IN PRINCIPAL CITIES

Patronize Your Local Oxygen Plant

SPEND YOUR DOLLARS AT HOME
for
OXYGEN

ACETYLENE WELDING EQUIPMENT — CARBIDE — HYDROGEN CUTTING EQUIPMENT

Members of the Gas Products Association can give you prompt and efficient service from over 100 plants and warehouses located throughout the country.
These are your local industries from which you will always obtain courteous, personal service. From them you will secure the highest purity of oxygen, acetylene and hydrogen and technical service, if you require it, concerning your welding and cutting problems.
Have you received your copy of the "Gas Welding and Cutting Flame?" It will tell you many interesting things about welding and cutting.
Write or wire to the nearest plant asking for a salesman or a service engineer, as your requirements may demand.

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Denver—Colorado Compressed Gas Co.
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Wilmington—Paschall Oxygen Co.

GEORGIA
Atlanta—Burdett Oxygen Co.

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Boise—Utah Compressed Gas Co., 319 Broadway, P. O. Box 499.

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BOLD FACE TYPE signifies Manufacturing Plants.
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Gas Products Association

333 N. Michigan Ave. Chicago, Ill.

First to Advocate High Purity Oxygen

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We Know What Happens in the Case of

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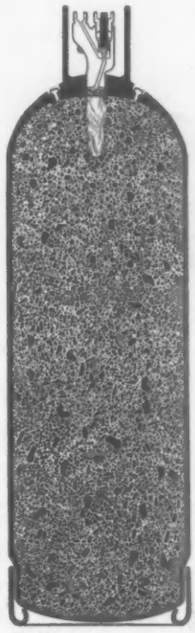
IF the rise in internal pressure, due to sudden extreme heat, makes it impossible for the fuse plugs to grant sufficient relief, the seamless shell will slowly bulge and split. The cylinder, however, will remain in place and in one piece.

It is impossible for Oxeco Seamless Monolithic Filled Cylinders to fragment.

Time after time cylinders of this type have passed through fires successfully, without endangering human life.



Acetylene producers, using Oxeco Seamless Monolithic Filled Cylinders, are assured of 100% safety at all times, and under all conditions.

There is no substitute for safety.

We are not manufacturers of acetylene. We are manufacturers of acetylene cylinders.

Booklet upon Request

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110 South Dearborn Street Chicago, Illinois

GUARANTEED *by Us* *and by* Experience

HOLLUP electrodes are guaranteed to give your welders the best results they have ever known.

If your welders say they don't like this wire—if they say it has too much splatter—or not enough penetration—or slows them up—

Or if the welding fails to stand up as it should—

We will replace the entire shipment or refund your money, as you prefer.

Is that plain and broad and fair enough? We have tried to make it so.

Your welders and your welding work furnish the answer.

Experience has proved to us that we can make this guarantee.

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C. H. HOLLUP CORPORATION
3333 W. 48th Place : CHICAGO

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Make the user of your product *feel* that it's a good weld, by smoothing the rough, raw surface left by the torch or the arc, to give all welded joints a smooth, dressy appearance.

Use SMOOTH-IZE For the Finish
A HOLLUP PRODUCT

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A FAMOUS scientist recently said "No industry can progress faster than the progress of the tools by which it does its work."

Look around you and see how true that is.

Natweld Gauges have always been a step or two ahead, and consequently have done their full share towards meeting the demands for progress in the welding field.

Stamped with the seal of approval by the Underwriters Laboratories, they have always had the seal of approval of equipment manufacturers and users.

That Natweld Gauges may always spell Progress, we urge you to use the services of our engineers in determining the proper types of gauges to install on your equipment.

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No matter what kind of welding you do--

OXY-ACETYLENE

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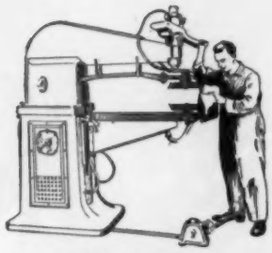

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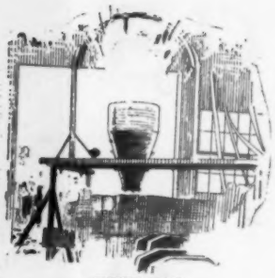

THERMIT

YOU NEED

The Welding Encyclopedia

New Sixth Edition

It describes in detail the theory and practice of every welding process.

It tells how to weld every weldable metal by each of the welding processes.

It gives detailed instructions for handling the important welding jobs, such as boiler welding, sheet metal welding, tank welding, pipe welding, etc.

It tells how to prepare parts for welding.

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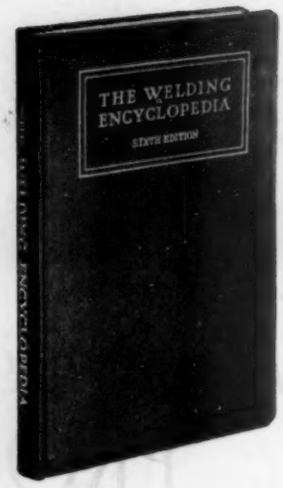

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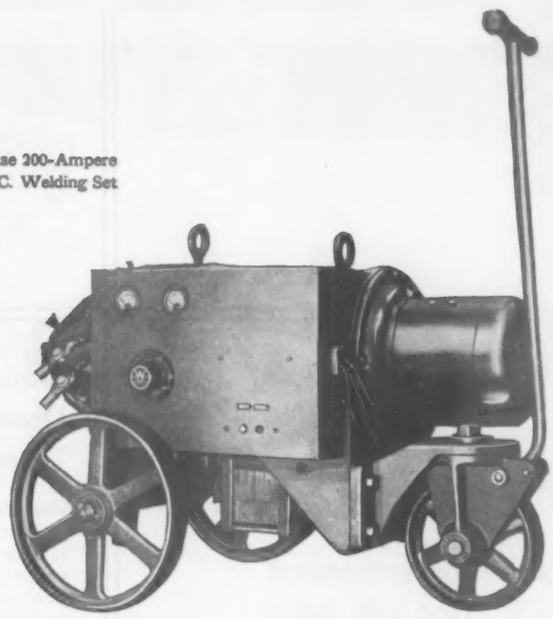

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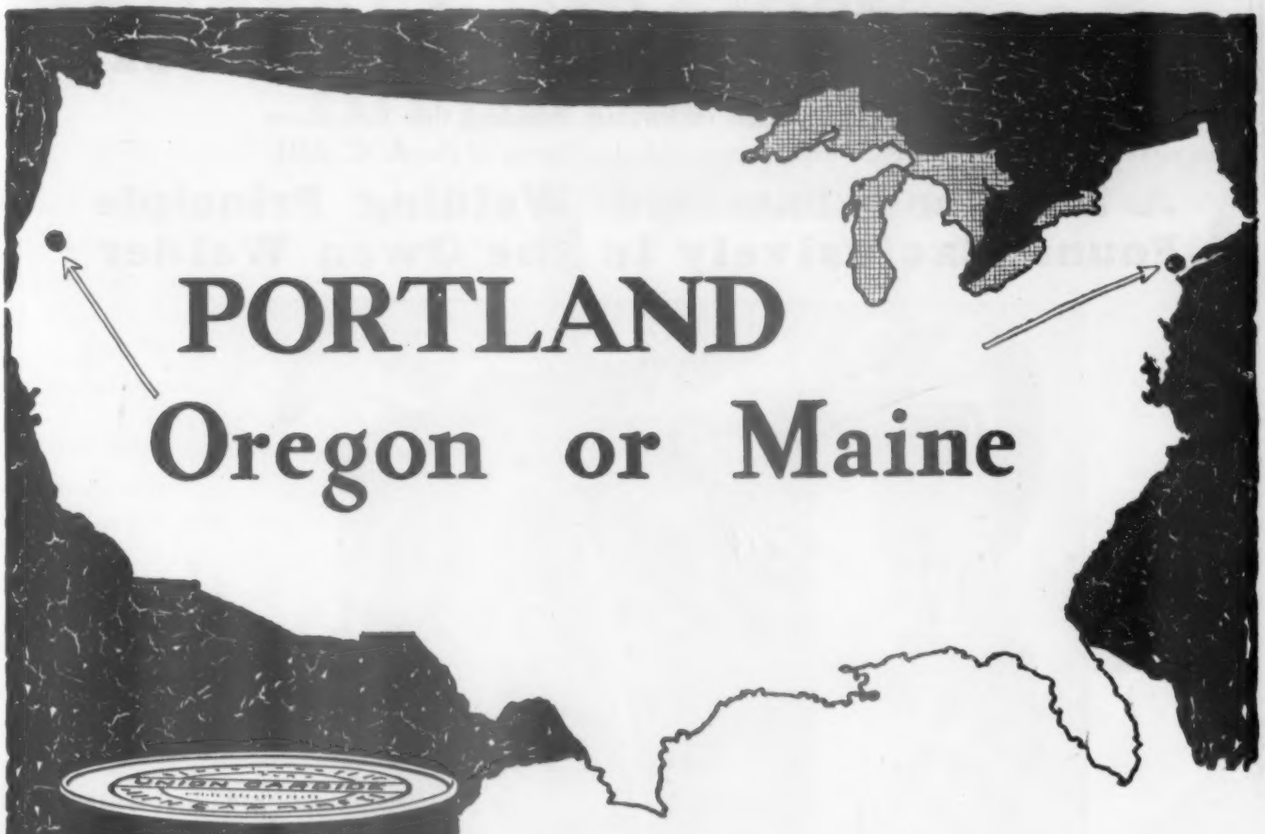

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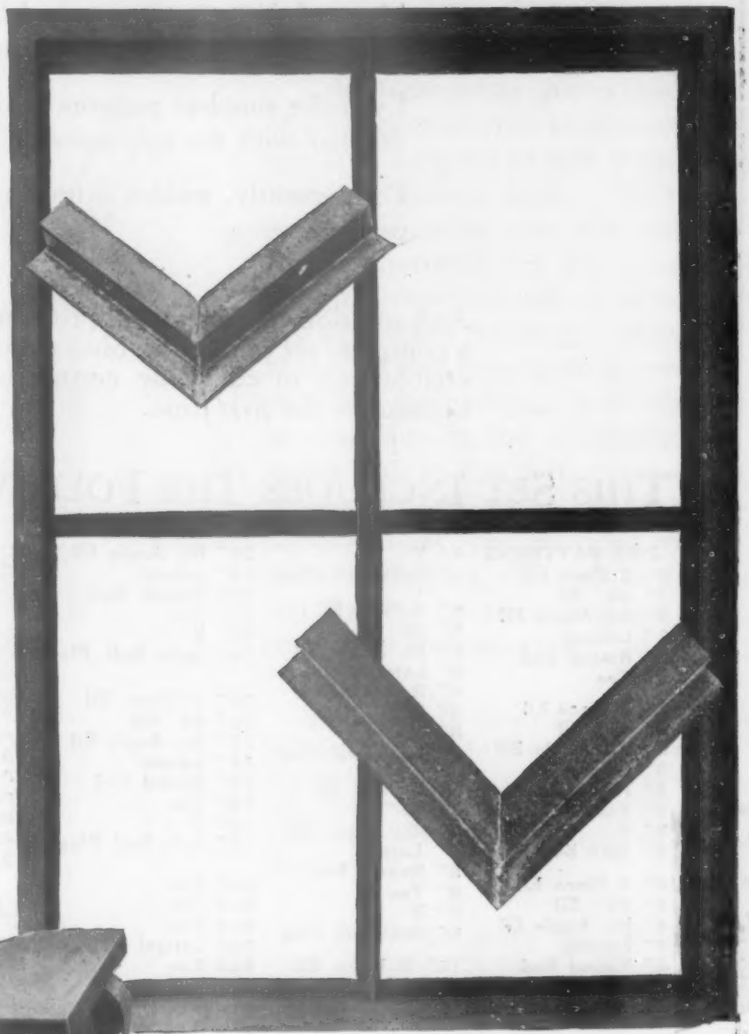

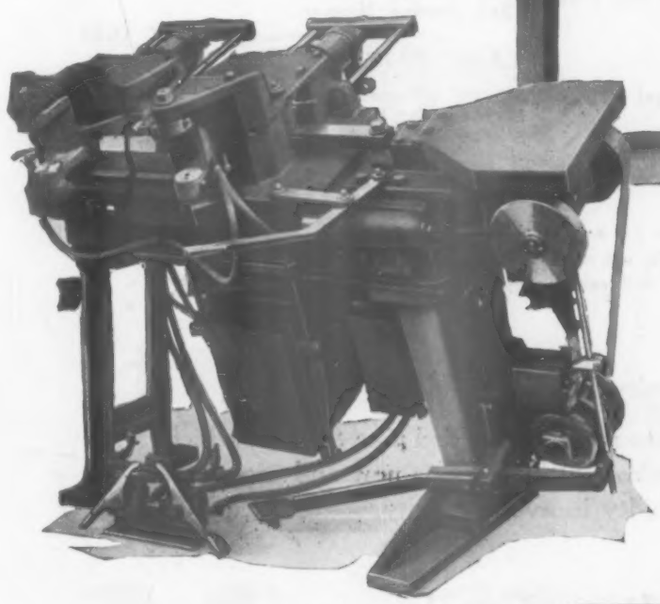

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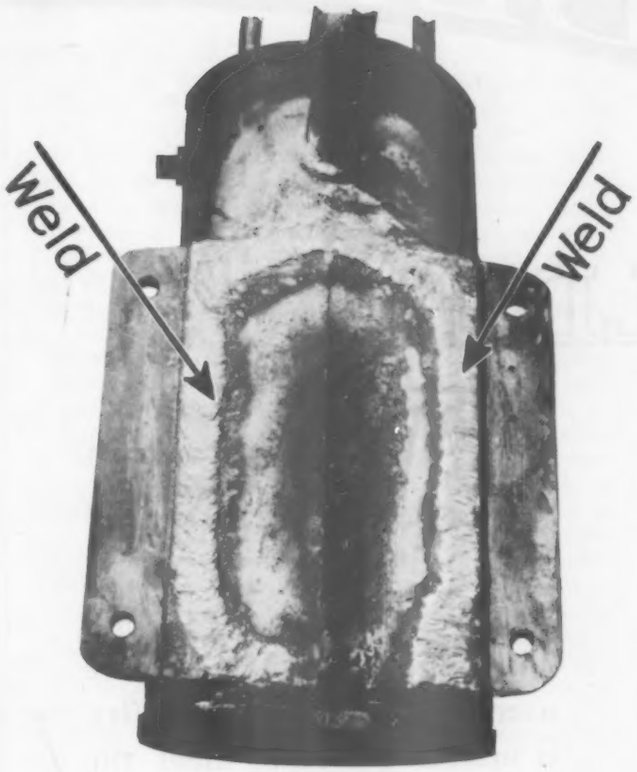

Photograph by courtesy of the
South Park Welding Works, Port Huron, Mich.

The illustration shows the cylinder of an International Harvester Engine repaired as good as new with Mueller Welding Bronze Rod. In this case Bronze welding was the only satisfactory method for the reason that the job required only a little warming up before welding. If any other material had been used it would have entailed preheating, resulting in all probability in the cracking of the inner wall of the water jacket owing to the expansion of the outer wall. In any event, the cylinder would require re-boring. With Mueller Welding Bronze neither pre-heating nor re-boring was necessary.

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EDITORIAL

Insist on Quality

IT IS not often that the day's work of a welding operator is deliberately held within limits by the employed, but one case which was recently reported shows very clearly that there is a lot of truth in the theory that good welding is usually economical welding. The man in charge of welding a pipe line intended for carrying gas at high pressure was, in this case, disturbed because several of the operators on the job showed signs of wanting to get it finished. Their attempt at higher speed did not result in the kind of welds which were accepted as standard. By way of experiment, a rule was made that only a certain number of welds were to be allowed in a day and that each welder should spend full time in finishing the allotted number of joints. In a short time two very important results were noticeable; first, a much better quality of weld; and secondly, a slightly lower cost per joint. The lower cost was partly accounted for by the fact that there ceased to be any necessity for re-welding and partly because the gas consumption was less when operators used more skill and less speed. This case is cited because it is so unusual to find an executive in charge of welding operations who fully realizes the false economy of speeding up operations beyond a reasonable point. It is well known that unsatisfactory results can almost always be traced to inadequate supervision or inadequate understanding of how to get a good result. Plant managers are beginning to realize that economies are effected more easily with good sense than by trying to secure high speed in operating departments. It is unfortunate that all users of welding do not realize what economy there is in taking the time to do every welding job right.

Human Nature and Welding

A GLIMPSE at the operating records of a large welding department yields information regarding the habits of the welder which are interesting, even though it may not be surprising. The installation of a recording device which gave an accurate record of just how much time each operator spent in depositing metal resulted in a considerable increase in the total production. Although the device was not installed for the sake of hurrying up the work of the welding department, the increase in production was so noticeable that a comparison was made with similar work done by machines which were not being checked. It took only a very short time to show that when the men knew that their percentage of productive time was being accurately reported they instinctively reduced the amount of waste time to a minimum, resulting in a big increase in the daily out-put without any decrease in quality on account of attempts at speed. Records taken at times when the department was not carefully supervised likewise indicated a falling off in production as compared to periods when supervision was more noticeable. Recording devices yield a great deal of valuable information to executives who are able to translate the records and take advantage of the lessons which they teach and, of course, are not at all necessary to show that welders are just as human as any other class of workmen. In this particular case they proved the point very clearly, while at the same time giving very valuable information for the use of the engineering department. Anyone who is interested in the development of a first class welding organization can take a very good fundamental lesson from this experience. That is, that welders are human, and the best welding organization will consequently be made up of the best kind of men that can be found to put to work on the job.

Vacation Reminiscences

WE HAD been bounding merrily over one of those macadam roads that have aged just long enough to develop a considerable kick, when a shattered spring put us in at a small town garage. The sun went down, and the moon came up, and the farmer boy mechanic was about to give up the struggle, all for the lack of a drill long enough for the job. Enjoying visions of a night in the wilderness, we inadvertently leaned an elbow on a cylinder of oxygen. The boy's eyes beamed. That's it! Simply weld an extension on the hill. In a matter of minutes a rod was welded onto the chuck end without drawing the temper of the business end, the piece was forged to shape, and the job proceeded without disturbing so much as a bolt in the rear end. Just an instance of how welding followed this editor over the country in his flight from Welding Engineer duties. Pipe line welding along the road side, welded tanks in the oil fields, welded motor boat on our lake, rail joint welding at a crossing, and welding shops everywhere, in cities, towns and hamlets. Speaking of welding shops, it was interesting and enlightening to observe the attitude toward welding in many of these little wayside shops. Some of the repair jobs we observed would be a credit to the maintenance department of any large plant. In other shops, the welding outfit was still a new-fangled thing that was handled with fear and trembling. The point is that in nearly every case the owner of the outfit displayed a lively interest in what the outfit could do, and was ready for all of the advice and information on the subject of welding that he could absorb. Farmers, house-wives, car owners, and manufacturers are learning from the livest of these shops what welding will do for them. We know of one shop, in fact, which has so thoroughly sold the community on the common-sense advantages of welding that a local manufacturer, marketing a metal product to the house-wives, found it almost necessary to change from riveting to welding his product. So it went, throughout that motor jaunt, everywhere evidence of the increasing part that welding is playing in industry and in the affairs of the individual.

The Truth Is Enough

VIRULENT youth is always prone to overestimate its powers and to essay to accomplish the impossible. Husky individual that it is, the welding industry is still in its youth, and perhaps for that reason is sometimes inclined to make claims for itself which raise the eyebrows of seasoned engineers. In the end, like all other individuals, works, not words, build reputation and confidence. Meanwhile, however, extravagant claims tend to hinder rather than to advance the cause. In planning high-pressure propaganda, as in designing high-pressure vessels, a safety factor should be allowed for. The user's subsequent discovery, that performance exceeds the claims, can do no harm, while setting up claims that cannot be lived up to works injury to the advancement of welding that is exceedingly difficult to compensate. In his article in this issue, S. W. Miller, a veteran in the field of welding, points out that although fusion welding has its limitations, it has already built for itself a reputation on which it can stand and hold its ground, and long-sighted advocates know that the greatest ultimate success and progress for the industry and for the individuals that make it up lies along the road of conservative selling and sound engineering. Welding that two years ago was called impossible is being carried out in regular production today. Youth is still ready to undertake the impossible. That is how so many impossible things get done. Meanwhile, however, welding must be sold on the basis of what it will do today, in spite of certain progress in sight.

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Designs for Structural Welding

Proper Consideration of Combinations of Stresses Is Fundamental in Developing Procedure for Welding of Important Structures

By Johs. Kjekstad*

THE fundamental laws which govern designs for welding are not definitely and generally understood, although there has been broadcast much information on welding, reports of tests, descriptions of certain jobs, scientific data, both chemical and metallurgical. The result is that engineers have been handicapped and in great many cases have sidestepped welding whenever possible, while others have overrated its apparent simplicity of application and the work performed under their supervision has been defective, and the advance of welding thereby retarded. Until engineers will be in a position to point out definitely mistakes in calculations and designs, and also be equally certain of what can definitely be approved, the welding industry will be held in check.

Without trying to go into the matter on a scientific and metallurgical basis in a manner that would require elaborate instruments and exhaustive laboratory tests to check, we are glad to submit for consideration what we consider the most important factors in the designing and building of welded structures, this information being based on some twenty years observation in the use of the electric arc and oxy-acetylene welding processes.

In an undertaking where welding forms an important link, the following features appear essential, and are here given in their order of importance:

1. **Design of the welded structures with a view to eliminating or minimizing "locked up stresses."**
2. **Thorough engineering and welding experience of manufacture in planning and supervising welded shop and field work.**
3. **Established organization of manufacturer with skilled welding foremen and welding force.**
4. **Proper method of welding, welding equipment and welding materials.**
5. **Inspection and testing of welded products.**

Referring to Paragraph 1 above, the complete elimination of stresses is in most cases impossible, but to reduce the stresses to a minimum where they are of no practical concern is a simple problem in nearly every welded structure.

The most common mistake in design made, and which is directly responsible for probably 95% of the few failures in welded structures is the apparent disregard of the facts: first, that metal, being heated, expands and in cooling contracts, and second, that the metal in a weld retains nearly all its original physical properties with the exception of ductility.

The important problems confronting a designer of welded structures insofar as safety and permanency are concerned are therefore mainly reduced to: first, avoiding locked up stresses from expansion and contraction, and second, to avoid designs in which the welding metal will be subjected to bending moments in the weld, resulting in fracture sooner or later due to the reduced ductility of the welding metal.

To illustrate our contentions, we refer to figures 1 and 2 showing two methods of joining metals by welding. We shall here confine the matter to electric metallic arc welding, although our contentions are equally true regarding oxy-acetylene welding.

Fig. 1 shows two plates arranged for a so-called "buttwelded" joint. Let us assume that the two plates are placed with the abutting edges running parallel in the same plane and spaced slightly apart. If welding operations are started at point *a* and progress uninterruptedly towards point *b*, the welding metal gradually contracts behind the arc and causes the two plates to be drawn together until their edges come in contact at point *b* after which the plates can move toward each other no more. Let us assume that the welding operation has reached point *c* when the the plates at point *b* have come in contact. The hot welding metal at point *c* and toward point *b* if the welding operation continues, will contract when cooling off and as the plates cannot move together any more, the contraction must result in elongation of the welding material and adjoining plate material. The elongation takes place after stresses have passed the elastic limit and as this lies very close to the ultimate yield point of the welding metal and that of the plate metal, it is obvious that the resulting "locked up stresses" may reach close up to the point of fracture and frequently beyond. In the latter case where fracture occurs it will naturally be remedied and is not apt to cause damage. Where real danger occurs, however, is when these locked up stresses do not reach the point of fracture during welding, testing or erecting operations, but result in fracture after the welded structure has been put in operation when a working stress might be added to those already existing.

In Fig. 3. this condition is shown in (a) representing a cylinder with its longitudinal seam (b-b) buttwelded. The direction and the extent of the locked up stresses are illustrated by the lines (c) and the curves (d). Let us now assume that the stresses represented by the lines (c) amount to an average fibre stress per square inch weld cross section of 45,000 lbs., which admittedly is high but entirely possible. We shall calculate what this would mean in a specific case as for example: With a cylinder diameter 60", test pressure 200 lbs., operating pressure 100 lbs., value in tensile strength of welding material 60.000 lbs. and a cross section per linear inch of buttwelded seam of ½ square inch we will have a:

Fibre stress on test of $\frac{30 \times 200}{½} = 12.000$ lbs.

Fibre stress under operating conditions $\frac{30 \times 100}{½} = 6.000$ lbs.

giving a theoretical factor of safety of 10 if the locked up stresses were disregarded or not known. If these are known and taken in consideration, however, and calculated on the basis of 45.000, the total fibre stress under test will be 57.000 lbs. and under operating conditions 51.000 lbs. with an actual factor of safety of only $\frac{60.000}{51.000} = 1.18$

Going back to Fig. 2., the two plates here represent a so called lap welded seam. The line (a-b) shows the edge of one plate overlapping and laid parallel to lower plate's edge indicated by the dotted line. If welding operation starts at point (a) and progress toward point (c) it will be found that the two plates at point (b) do not change their relative position. In other words, there is no movement of the plates toward each other as the case was in Fig. 1.

Although there may seem to be an inconsistency of action in these two apparently similar designs as far as concerns the presence of heat, the cooling of the welding metal and necessarily its contraction, the reasons are simple for the very important difference of: destructive stresses in one case (Fig. 1.) and total

*Chief Engineer, S. O. S. Welding Corporation, Brooklyn, N. Y.

absence of or negligible stresses in the other case (Fig. 2.). The reasons are the following:

In Fig. 1.

a. The lines of contraction run parallel to the neutral axis of the abutting plates. (See Fig. 4.).

b. The heat from the welding can only be absorbed by and radiate from the two plates adjacent to the weld.

c. The buttweld for a given thickness of plate has a larger cross section, requires more time for the deposit of welding metal per linear inch of seam with attendant greater amount of heat being accumulated, resulting in increased contraction.

In Fig. 2

a. The lines of contraction run approximately 45 degrees to the neutral axis of the plates. The contraction therefore is taken up in this direction (See Fig. 5) and eliminates contraction parallel to the neutral axis.

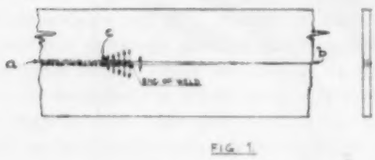


FIG. 1.

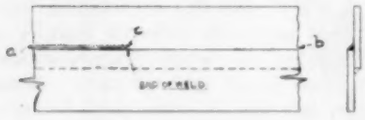


FIG. 2.

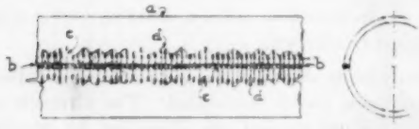


FIG. 3.

FIG. 4.

FIG. 5.

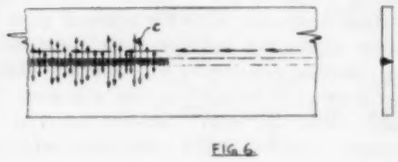


FIG. 6.

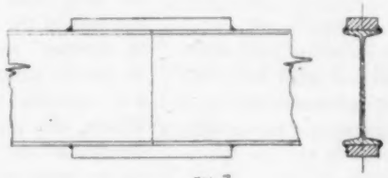


FIG. 7.

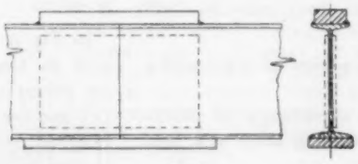


FIG. 8.

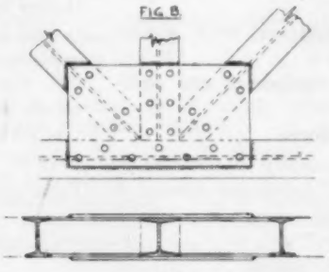


FIG. 9.

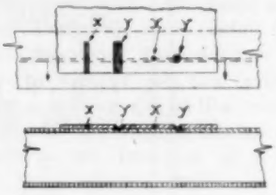


FIG. 10.

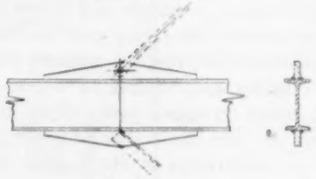


FIG. 11.

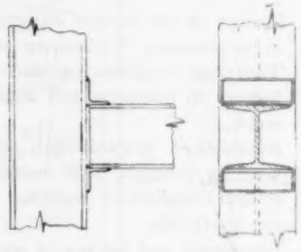


FIG. 12.

b. The heat from the welding is absorbed by and radiated from the plates adjacent to the weld in three directions. (See Fig. 5.).

c. The lap weld for a given thickness of plate has a considerably smaller cross section per weld requiring less time for the deposit of welding metal per linear inch of seam (one side) has greater radiating capacity, (as pointed out under Par. b) resulting in a lesser amount of heat accumulated and decreasing contraction to a minimum. There is also the fact that the two plates in a lapped seam, even though they may be bolted up, leave a slight opening between the two surfaces in the lap, which is sufficient to allow the contraction to take place without causing locked up stresses.

These acts are true in practically all cases of welded structures be it straight plate work, pipes, tanks or structural steel.

A method of eliminating locked up stresses in buttwelded seams has been advocated. This method is called the "Backstep" method and merely consists of welding a seam in series of short welds, (see Fig. 6), each weld being a continuous weld of a few inches in length, started away from the last completed weld and running back to the beginning of the last completed weld.

The lines of contraction and extent of locked up stresses in this method is illustrated by the lines c (Fig. 6) and shows that the maximum stresses occur where each individual weld ends. The average fibre stress in pounds per linear inch of seam, however, is practically the same in this method as in the usual method of continuous weld of a buttwelded seam.

Another method is to caulk or "bump" the weld with a pneumatic hammer but if not done in a certain expert manner, the result is often increased instead of decreased stresses.

Going back to our essential feature and referring to items 2, 3 and 4, it is sufficient to state that welded products requiring safety and permanency should only be undertaken by an organization with thoroughly experienced engineers and in a position to establish a record of past performance of similar undertaking.

Referring to item 5., the inspection and testing are of minor importance except insofar as it may lead to the discovery and rectifying of possible mistakes in design, lack of ability or integrity on the part of manufacturer or his organization, and finally the possibility of faulty material or workmanship.

All of these possibilities are remote, however, if the conditions as outlined under the preceding paragraphs are adhered to.

Great care must be exercised in design of structural steel for welding particularly in considering combinations of stresses. The change from riveted to welded connections in structural steel is thus a most radical departure compared with ordinary steel work. For example plate-construction where the efficiency of the seams involves no great complications of stresses.

Proper designing of connections in structural steel for welding is also founded on simple basic principles. Primarily designs must contemplate factors which prevail in all endeavors involving human skill, namely, thoroughness and trustworthiness. Welders are as human as the rest of us; they will occasionally disobey orders; they have their offdays, and they may perform low quality work occasionally or persistently without being discovered. One must

provide for these considerations and not offer alibies blaming the welders for failures after they occur. The fault lies with the designer in nine cases out of ten and not the welder or the engineer on the job.

The general rules for welded structural steel design are based on the same argument previously pointed out, and can be concentrated in the following classifications.

RULE 1. AVOID BUTTWELDED CONNECTIONS IN STRESS-MEMBERS.

a.) Provide gusset-plates, buttstraps or fishplates for stress member connections, the total net cross section of such plates or straps to be not less than the cross section of the member. If cross-sections of the two members to be joined are unequal the larger section is to form the basis for calculating the section of the joint-members.

b.) Provide a total cross section of weld between joint-members and main members fifty per cent in excess of the total cross section of joint-member. The disposition of joint-members and welding to main members to provide an equal distribution of stress in the welds.

Paragraphs a.) and b.) are illustrated in Fig. 7, which shows an I beam joint with a butt-strap or fish-plate along and outside of both flanges.

Let us assume the cross-section of the I beam is 20sq." the width of the flanges 6". The cross-section of each butt-strap will, therefore, be 10sq." To leave sufficient space for welding along both edges of butt-strap we will choose a plate 5" wide leaving half of one inch of flange on each side of butt-strap. This plate will be 2" thick to provide a 10sq." cross-section. The next question is how long to make the butt-strap on each side of the joint. A 15sq" cross-section of weld is called for and the ½" space on the flange of the I beam provides for a ½" x ½" filletweld between butt-strap and I beam, consequently a total length of welding of 30 lin. inches must be provided for. The end of the plate being 5" wide will provide for 5 lin. inches of welding leaving 25 lin. inches to the two sides or 12½" to each side making the length of the butt-strap 12½" long on each side of the joint or a total length of 25".

A bottom butt-strap is more conveniently made with a wide enough plate to provide down welding as shown in Fig. 8. The bottom-plate would be approximately 7" x 1½" x 30", the length in this case being increased to provide for 30" lin. weld on each side of joint without the inconvenience of overhead welding. The weight of the butt-straps can be greatly reduced by tapering down thickness or width or both from the joint out to the ends. The size of the butt-straps can also be reduced by using butt-straps on the web of the beam as shown by the broken lines on Fig. 8.

RULE II. AVOID BUTTWELDED CONNECTIONS IN COMPRESSION MEMBERS WHICH MAY BE SUBJECTED TO TORSIONAL STRESSES.

c).Provide gusset-plates with proper cross-section to hold members in position and to take torsional or bending-stresses.

d). Provide cross-section of individual welds between gusset-plates and members fifty per cent in excess of calculated total required cross-section of rivets in similar connection.

Paragraphs c.) and d.) are illustrated in Fig. 9.

The gusset-plates can in most cases be welded from both inside and outside if needed to provided necessary total weld section. Rivet-welds as shown will also provide additional weld-section if desired. Holes punched for rivet-welds should have a diameter not less than twice the thickness of plate. If slot-welds are used instead of rivet-welds, the width of the slot should not be less than twice the thickness of the plate. In both cases this is necessary to enable the welder to make a clean and homogenous weld without difficulty as the welding material in the center of the hole or slot has little value if there is lack of penetration on the sides of the hole or slot. Both conditions are illustrated in Fig. 10, being incorrect, and y the correct condition.

RULE III. AVOID BUTT-WELDED CONNECTIONS IN LOADCARRYING MEMBERS SUBJECTED TO BENDING MOMENTS OR SHEAR-STRESSES.

e.(Provide butt-straps as shown in Fig. 7 or 8 under rule 1. Par. a.), and b.), calculations based on providing proper cross-section for butt-strap in tension relation to portion of member in tension. The portion of the member subjected to compression stresses only is provided with butt-strap calculated on the basis under rule II. Par. c.) and d.). If portions of members are alternately subjected to tension and compression butt-straps are to be calculated on the basis of stress-members. If such members primarily take-up bending-stresses, is is practical and convenient in some cases to place the connection members as shown in Fig. 11, which does not reduce the cross-section of the butt-strap at the line of connection but faciliates an easier reduction of weight of the butt-straps, and also provides for extra connection in way of joint if desired as suggested by the broken lines. Consideration must be given in this case, however, to the possible occurence of torsional and lateral stresses.

f.) For connections in shear provide gusset-plate or brackets with a total weld cross-section fifty percent in excess of calculated total required cross-section of rivets in similar connection.

Paragraph f.) is illustrated in Fig. 12 and 13.

In welded connections it may be desired to eliminate any open abutting edges and faying surfaces such as for example in bridge

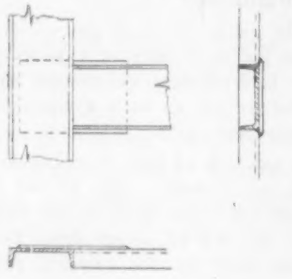


FIG. 13.

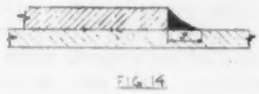


FIG. 14

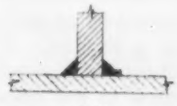


FIG. 15

structures subject to the elements and susceptible to excessive corrosion. All such openings or cavaties should be sealed with only a light weld sufficient to keep out moisture but in no case heavy enough to set up contraction stresses or be depended on to take any structural loads.

Wherever possible heavy welds should be avoided and it is well to use a small weld cross section with longer weld than a large weld cross section with shorter weld. For example if a butt-strap is to have a total weld section of 10 square inches along a one inch thick plate this weld should preferably be dimensioned ½" x ½" x 20 linear inches instead 1" x 1" x 10 linear inches the actual deposit of welding material being 2.5 and 5 cubic inches respectively. This method is in most cases the most economical but more important it tends to further eliminate locked up stresses as less concentrated heat along the line of welding is accumulated.

The cross section of a weld as referred to in this article is based on the shortest side (x) of a triangular fillet weld as shown in Fig. 14, as the determining factor, as a longer side (y) gives no additional value to the efficiency of a weld. A weld indicated by the measurements ½" x ½" shows both sides (x) and (y) being equal which is the logical method of dimensioning a weld with a few exceptions such as for example where a round

rod is welded to a plate as shown in Fig. 15. If the dimension of the weld in this case is made equal to approximately half the diameter of the rod and with equal sides, the weld-surface will be almost four times the cross section of the rod and almost forty per cent in excess of the weld-surface to the rod. For such cases proper weld dimensions should be provided for.

The value per square inch of weld-surface in tension, compression or shear, is debatable and we shall not enter into this phase of the subject here. A butt-weld in contrast to a lap-weld, is probably difficult to define as applicable to all designs of welded joints or connections. The expressions, however, are common and generally understood and might be classified as follows:

A butt-weld is the joining by welding between two members both of which are inflexible in the direction parallel to their respective neutral axis and or where lines of contraction in the weld run parallel with the neutral axis in one or both members.

A lap-weld is the joining by welding of two members, at least one of which is flexible in the direction transverse to its neutral axis, and or where lines of contraction in the weld are not parallel to the neutral axis of any one of the two members.

When those in the welding industry realize, preach and practice the simple doctrines of welding which we have tried to illustrate, failures should be extremely rare and the joining of metals by welding universally adopted as not only more economical, but also as far safer than any other known method.

If this article has been effective in pointing out the pitfalls encountered in welding, and has pointed the way to a better understanding of the fundamental requirements for a conservative and successful growth of welding engineering to those who are skeptical without knowing exactly why, and yet sufficiently progressive and eager to advance, it will have well served its purpose.

A FENCE THAT DOES NOT SAG

By W. D. Flannery*

A time generally comes when the owner of every plot of improved ground finds it necessary to put up a fence of some kind to separate his property from the land adjacent and prevent encroachment. Last year we decided to put up such a fence to enclose a garden where choice flowers were grown.

Just what kind of fence to erect and how to build it was something of a problem. It worked out, however, that we set 4 inch boiler tubes in concrete, 6 feet out of the ground, and then cut notches in the tubes at the top and 10 inches from the ground level. Two-inch pipe was used for the runners, and was set in the posts so that the sides were flush with the inner face of the posts. The 2-inch pipe was welded to the posts, and so around the plot.

Our reason for keeping the fence posts and runners on the same line was that when we put up the 6 foot anchor wire fence it would lie flat against the posts and fence rails. We then welded the fence at every foot or so, top and bottom, as we went along, and when all the wire was in place, we then filled each post with concrete. Today there is no sagging in the fence, nor does it flop against the post or rails. To strike it with a hammer it has the ring that says, "Well done, I am here for a life time."

Now, the best part of this job is it costs less than wood, and when painted it looks far better than wood. The 290 feet of fence was made up of scrap pipe and boiler tubes. The fence is not hard and offensive for others to look at—and last summer's flowers were not taken away. We have here one of many examples of both domestic and industrial construction problems solved by the oxy-acetylene process. The International Acetylene Association, 30 E. 42nd St., New York City, is making an extensive investigation of practical ways to solve such problems and its Oxy-Acetylene Committee reports that new developments of the welding art are making possible many uses which were not considered practicable a couple of years ago.

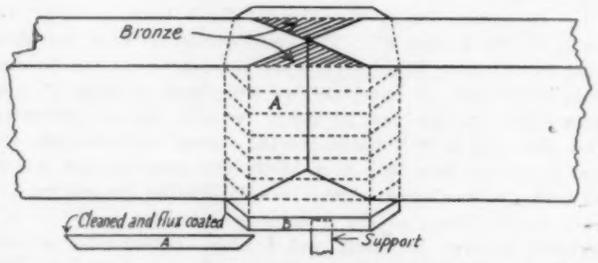
K-G Welding & Cutting Co., Inc., New York City.

NEW DESIGN OF WELDED JOINT FOR LOCOMOTIVE FRAMES

There have been some very interesting developments during the past couple of years in the use of bronze for the welding of locomotive frames. This method has been adopted by a number of railroads and some of them are at the present time using it to the exclusion of all other methods.

In a recent paper on the subject of bronze welding locomotive frames, one railroad welding supervisor pointed out that his first experiment in heavy bronze welding dated back about four years and that since that time he has supervised the welding of more than three hundred locomotive frames by this process. A summary of the cost figures of some welds shows that two welds in a 5 by 6-inch frame cost a total of $38.10. A single weld in a 5 by 6-inch frame cost $24.98, including the removal of an old electric weld. A 6 by 7-inch frame cost $15.91 to weld and a double weld in a 7 by 8-inch frame cost $21.35.

During recent months one of the railroads has been experimenting with a new type of procedure which, on account of the reduced time required for its completion, is expected to make still further reduction in the cost of welding and at



Side View of Bronze Weld Showing Shape and Method of Applying Individual Beveled Plates as Weld Progresses. A Indicates Shape of Beveled Plate and in Place.

the same time give a better appearing and stronger repair.

The accompanying sketches will serve to show the principle of this new development. In order to make it easier for the operator to control the melted bronze, there is not only a big plate used, but strips of steel plate beveled as shown in the illustration are added one at a time across the opening of the Vee as the weld progresses upward. These strips are very carefuly cleaned of all scale and oxide and the surface is covered with flux before they are applied. It was found in making the first welds by this procedure that sufficient heat is developed to cause the bronze to alloy with this steel strip as well as the ends of the frame. There is also sufficient heat developed so that there is bronze union between the ends of the strips and the surface of frame ends where they overlapped. Consequently, when the weld is finished, these plates together with the bottom plate form a very important steel reinforcement of the job. This procedure appears to have three distinct advantages. In the first place, it is easy to get a very neat looking repair which wins the confidence of those who are not well enough posted on the theory of welding to know how strong the bronze joint would be without it. In the second place, it makes it so much easier to control the melted bronze that much less time is consumed in making the weld. In the third place, if properly done it makes a very strong joint. Some frames have already been prepared by this method and are reported to be giving splendid service.

Air Reduction Sales Company have acquired all of the assets of the Ohio Oxygen Company, who have operated an oxygen plant at Niles, Ohio.

Some General Thoughts on Welding*

Influence of Fluxes and of Chemical Composition of the Rod in Protecting the Weld from Oxidation, to Give Greater Strength and Ductility

By S. W. Miller†

THE term "fusion welding" is properly applied to any process by which two pieces of metal are joined, either by melting them together, or by applying additional melted metal between their melted surfaces. It is different from brazing or soldering in that in the latter cases only the added metal is fused. It differs from forge or hammer welding in that in these processes the metals joined are not fused, but brought only to the temperature that allows them to be pressed or hammered together so that a solid union may be made. In all cases in which these processes are properly carried out, the union is molecular. The difficulty with any of them is to avoid the inclusion of oxides or other dirt between the pieces or in the weld metal.

Fluxes have been used for years with soldering and brazing to remove these oxides, or to prevent their formation, and their use has accomplished the desired results. Also the use of borax or sand by the blacksmith in his forge welding is an old practice.

There is another method that will answer the purpose in some cases. It is to put into the materials to be joined the elements necessary to do the fluxing. Comparatively high phosphorus in pipe skelp is one instance, and the use of low carbon steel for forge welding is somewhat analogous.

In fusion welding the need of fluxes is great in some cases, as for example with brass or bronze, or cast iron. They are not used so much in the case of steel with either gas or arc welding, although many coatings and similar methods have been devised, especially for arc welding.

It is probably true that where it is possible to incorporate suitable elements in the rod itself, better welds can be made than where the deoxidizing or slag-forming elements are in the form of a coating or covering. Such elements as manganese and silicon, that oxidize preferentially carbon and iron, not only greatly decrease the oxidation of these latter elements, but add strength ot the weld when present in proper amounts. Their action is the natural result of oxidation, their oxides combining with the iron oxide formed to make a thin, rather viscous slag, that does not prevent the transfer of heat to the metal, but prevents the access of air to it. Not only is the weld metal protected, but the fluidity of the slag allows it to run ahead of the weld metal onto the base metal, cleaning it and allowing of rapid and sound welding.

*Reprinted from July, 1928, issue of the Transactions of the American Society for Steel Treating.

†Union Carbide and Carbon Research Laboratories.

The following analyses show what occurs in gas welding:

	Rod Per Cent	Weld Per Cent
Carbon	0.20	0.17
Manganese	0.80	0.50
Silicon	0.55	0.30

With the usual welding rod, that contains about 0.06 per cent carbon, 0.15 per cent manganese, and practically no silicon, it is evident that the weld must be more or . oxidized, and this is found to be true. Also its strength must be less than that given by a rod of proper composition. This has likewise been found to be the case. A great additional advantage of the better rods is that in all cases they make the welding easier, so that after a few hours' practice, the welds made by the average welder are stronger and better in every way, the strength increasing from 15 to 25 pr cent, and the general quality of the weld being much better.

The author has selected one rod and one process as an illustration, but desires to bring out the point that careful metallurgical study is needed with all processes if we expect to improve the quality of welding and broaden its application.

Fusion welding is a very attractive process, because of its cheapness, and the wide variety and ease of its application. It results in a joint that in most cases is unequalled for strength, tightness, reliability and safety. In other cases the inherent conditions are such that it is impossible to expect the best results, and in a few instances the results are quite unsatisfactory. But it is no different in this respect from other methods of joining, no one of which is suitable for all cases, and it has such marked advantages where it is applicable, that it is very rapidly replacing older methods in many instances, as well as making new fields for itself.

The characteristics of a fusion welded piece depend on the process employed, and on the materials used, both base metals and welding rod, so it is not possible to state them generally. It may be said, however, that weld metal naturally cannot equal forged and heat treated alloy steel in physical properties. As a corollary of this, fusion welding should not be used where such results are required. Good weld metal, made by commercial welders, may have 65,000 pounds per square inch ultimate strength, 48,000 pounds per square inch yield point, 25 per cent elongation in 2 inches, and 40 per cent reduction of area.

These figures apply to the weld metal itself when it

is of the proper composition, and are for gas welding. It may be well to point out that the yield point of such weld metal, and also of some others, is considerably higher than that of ordinary steel plate. Therefore, in an ordinary welded tensile test piece there is but little elongation across the weld.

Two recent papers, one by A. B. Kinzel, read before the A. S. S. T. at the last meeting in Detroit, and the other by W. B. Miller, read at the same time before the American Welding Society, show that consistent and accurate results as to the ductility of weld metal can be obtained by a suitable bend test.

This difference in yield point, however, is of no importance in practice, because welded structures are not stressed beyond the yield point, and the coefficient of elasticity is the same for both weld and base metals.

To attain these values in practice, proper procedure must be followed, beginning with the design, and including proper selection of materials, correct training of the welders, inspection and supervision. Successful fusion welding is not a haphazard process. Consistently good results cannot be obtained in any work by hit and miss methods. There is, therefore, every reason for applying the same careful study to welding that we naturally apply to other processes.

Fusion welding, like anything else, has its limitations, but scientific study is gradually removing them. As an illustration, the case of welding copper-tin alloys may be cited. One common alloy is 90 per cent copper and 10 per cent tin. In castings that cool fairly rapidly, such as those of moderate size, the delta constituent is present in considerable amounts, although copper will dissolve more than 10 per cent of tin when the alloy is in equilibrium, and then only the alpha solution is present.

The delta constituent has a lower melting point than the alpha constituent, so that when welding a 90 copper 10 tin bronze containing delta constituent, it boils out on the surface before the alpha constituent is melted, and is absorbed by the melted metal from the welding rod. There are two results: first, a heavy concentration of tin next to the weld line, making the metal at that point brittle; and second, the formation of cavities in the base metal a short distance from the weld line, due to the removal of the delta constituent, through which cavities the rupture always occurs under test. Apparently it is not possible to weld such material successfully.

But the equilibrium diagram shows that above 930 degrees Fahr. (500 degrees Cent.) the alpha plus delta constituent structure changes to the beta solid solution, and that the beta solid solution can contain nearly 30 per cent of tin at about 980 degrees Fahr. (525 degrees Cent.). So if the piece is heated to 980 to 1020 degrees Fahr. (525 to 550 degrees Cent.) for a long enough time for the beta to form, the welding can proceed without danger from either of the causes mentioned. The rate of cooling should be about that of the original casting.

Even so common a job as welding cast iron, was in the early days of welding, thought to be impossible. The welds were porous, dirty, hard, brittle, and unmachinable. An excess of silicon in the welding rod, and the use of suitable fluxes, were mostly responsible for the good results now obtainable.

It appears to the author that the members of the American Society for Steel Treating are peculiarly qualified by their technical knowledge to look at welding problems with clear vision, especially where steel is involved, and I would urge on you to apply this knowledge to the study of how you may use fusion welding to advantage.

There are many sources of information on which to draw, and good commercial organizations that sell welding apparatus and supplies are also selling welding—good welding—to their customers through their service departments.

You naturally ask, "Where can I use fusion welding?" I think the best answer I can make is that I cannot make out a list of applications, but that each of you should study his own problems in the light of available information as to the characteristics of weld metals, but not forgetting that things that were formerly thought impossible are now being done as a matter of course, and that careful thought and research will show that the possibilities are very numerous and that the successful applications will be many.

Cost of Welding

Of course, cost is always an important consideration. But cost figures should come from the accounting department and not from the shop, if accuracy is desired, as there are elements in the total cost that the shop cannot know of. Different companies have different methods of accounting, but they all give results that are suitable for comparisons. The cost of welding is not the only consideration, as welding may reduce other costs enough to pay the welding expense. All these matters, upon which real cost depends, are proper subjects for careful consideration of the management, before any decision is made. Low cost is often deceptive, as a cheap process may not give good results, while a higher welding cost may be fully justified by the superior product obtained.

I speak of all this because welding cost figures are often given with little regard to the facts. For instance, I once received a letter from a manufacturer of a welding machine, in which it was stated that his machine could be operated for ten cents per hour, which evidently would not cover the cost of the current. Such statements will not bear analysis, and should not be accepted at their face value.

ARMCO IRON NOW OBTAINABLE IN PLATE FORM

For many years Armco pure ingot iron has been obtainable in sheet form, but only during the past year has it been available in plate form of all commercial sizes and thickness. For those who desire data regarding the physical properties and weldability of this product, the American Rolling Mill Co. have issued a booklet titled "Pure Iron Plates for Long Service." Considerable space is devoted to an explanation of the welding qualities of Armco iron, with both the oxy-acetylene and electric arc processes. This booklet can be secured from branches of the company or from the main office at Middletown, Ohio.

Oxy-Electric Underwater Cutting

Sheet Steel Piling Readily Removed Fifty Feet Below Surface by Combination of Electric Arc and Oxygen Jet

By L. F. Hagglund*

In the construction of the new Hudson River Bridge, from Fort Lee, N. J. to New York City, and of the new Albany Ave. Bridge at Atlantic City, N. J., underwater cutting operations played an important part.

In the construction of the stone piers for the Albany Ave. Bridge, steel sheeting had been used for cofferdams, and within these cofferdams the piers had been built in the dry. To make the steel pile dams water tight, wooden splines had been driven into the interlocks of the piles.

Upon the completion of the piers the steel pile cofferdam wall was to remain in place to serve as a protection against underscouring by the river current. However, the projection of this steel wall above the water level and in front of the stone piers was unsightly, and to eliminate this the contract required the cutting off of approximately 900 steel sheet piles below low water level.

Steel Sheet Pile With Cut Which Was Made Under Water.

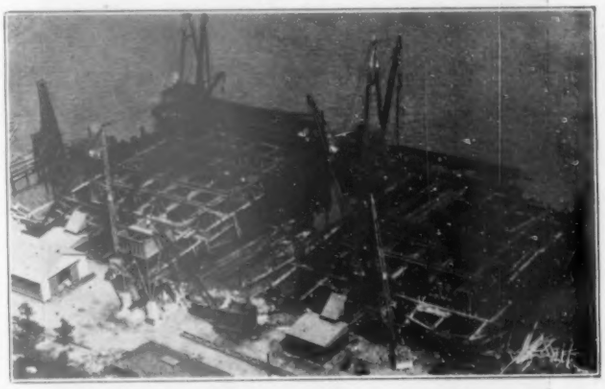
Divers with oxy-electric torches, furnished by Under-Water Metal Cutting Corp., New York, began on October 17, 1927, the work of cutting the steel sheet walls under water. The divers worked from a staging placed and moved along the face of the wall as the work progressed.

The oxy-electric torch used combines the heat of the electric arc together with oxygen under high pressure. By means of a specially constructed electrode the jet of oxygen is directed onto the metal where the arc is acting. The heat of the arc even under water will melt the metal and the oxygen acting on this molten metal tends both to oxidize and to blow it out of the cut.

To furnish the necessary electric current for cutting, a small motor-generator was set up at the shore line and leads run out to the bridge piers. The oxygen was obtained from tanks the same as for oxy-acetylene cutting above water.

During the progress of the work, an attempt was made to determine the actual cutting time, as it differed considerably from the diving time. To get the actual cutting time, a recording meter was placed in the circuit used by one of the divers. From the resulting graph obtained, which is here reproduced it was easy to differentiate between diving and cutting time, which permitted closer and more accurate calculations upon this type of work than had ever before been obtained.

In approximately four weeks the work was completed by two divers. The number of piles cut per day, per diver, was approximately fifteen, and on each of these piles, the



Showing Hudson River Bridge Piers, Fort Lee, N. J., with Steel Sheet Piling Cofferdam in Process of Construction.

cut had to be made through a wood-filled interlock approximately four inches thick.

During May of this year a similar job was completed on the New Jersey pier of the Hudson River Bridge from Fort

Removing Steel Sheet Piling From Completed Bridge Piers by Cutting Piles at Depth of 50 Feet Under Water. In Upper Left Are Shown Divers Working From Floating Derrick.

Lee, N. J., to New York City. In this case, however, the steel sheet piling had been driven into hard bottom and upon completion of the pier foundations considerable difficulty was experienced in pulling the piles owing to distortion of the original shape.

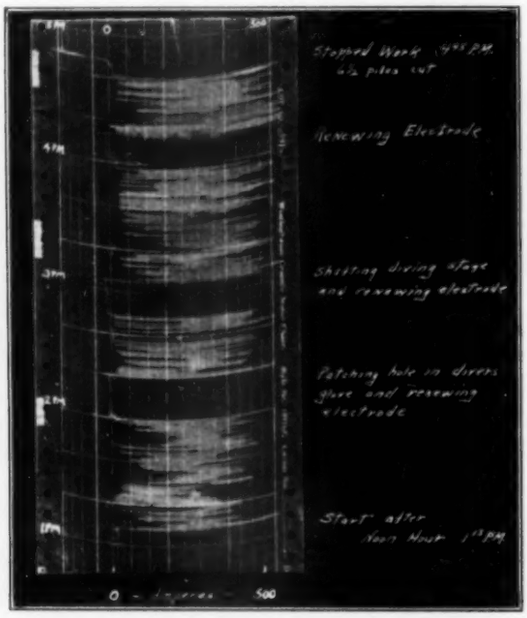
To facilitate the removal of the sheeting the oxy-electric torch was used at a depth of 50 feet to cut the piling on a line with the river bottom. Two divers were employed to do the work and the best day's work resulted in 40 piles cut. In this instance the interlock of the piling was free and clear but a strong river current tended to handicap the divers and very muddy water obscured the work.

*Under-Water Metal Cutting Corp.

Following is a description of the under-water cutting method:

One lead from the generator is connected to the plate to be cut. The other lead through the necessary circuit-breakers and resistance terminates in a manifold at the upper end of the cutting hose. The oxygen hose from the tank gauge valve also terminates in this manifold. Both the oxygen and the electric current then are conducted to the torch through this hose, which contains a copper wire conductor. This wire terminates in a brass coupling into which the electrode holder fits.

A carbon electrode 12 inches long, and containing several small holes drilled lengthwise through it, is clamped in the brass electrode holder, the holes making an air-tight connection with the holder at one end and sealed at the other. This electrode holder is then screwed into the hose coupling and the torch is ready for use.



Ammeter Placed in Circuit Records Actual Cutting Time.

The diver descends with the torch and when in position and prepared to burn, signals his attendant. The current and the oxygen are turned on, the diver strikes an arc upon the metal, and immediately the oxygen jets are opened and the blast of oxygen is directed through the electrode toward that spot on the metal where the arc is playing.

No protection of the arc from the surrounding water is necessary as the intense heat of the arc immediately transforms the adjacent water into steam and the arc continues to function enveloped in a constantly forming bubble or blanket of steam. The oxygen under pressure directed on the metal heated by this arc both oxidizes and blows the molten metal out of the cut.

The electrodes cooled by the surrounding water last approximately half an hour and are easily replaced.

The torch can be used by the average diver without any danger to himself, and with fairly good results, provided he is properly instructed, but, of course, the best work is performed by experienced operators.

EYE PROTECTION KEEPS PACE WITH WELDING ADVANCEMENT

By T. A. Walsh*

THE welding engineer is continually developing the art of welding, making available for the use of industry a wider range of welding processes and uses, but with this electric welding development, utilizing higher temperatures, there is created a serious eye hazard situation. The eyes of the welder must be protected against these harmful rays, and this is a problem whose solution is in the hands of the manufacturer of welding eye and face protection.

It seems only yesterday that we marveled at the adaptability of the carbon arc for industrial use in welding operations. This same process of only yesterday, through the assistance of the technical research laboratory has developed to a point where in many industrial operations it is the chief producing factor.

Through the same avenue of scientific research the welding engineer has brought to the stage of practical use the welded building, bridge, and machine from base to assembled unit. In producing these results through the rapid evolution of this new industrial process, temperatures of varying intensities created by the use of the electric arc have been the tools of man.

It is therefore of concern to see that sufficient consideration is given to adequate protection of the eyes of persons engaged in welding operations. Radiations from intensely heated solids or vapors may be divided as follows:

1. Invisible infra red rays.
2. Visible light rays.
3. Invisible ultra violet rays.

There is no clear line of demarcation between these divisions as they blend gradually, one into the other, like the colors of the visible spectrum but the radiations of the three subdivisions produce very definite effects upon our senses. For example, the infra red rays produce the sensation of heat when they fall on the unprotected skin. It is from them that the welder has the sensation of "hot sand in the eyes" or his eyelids take on the hue of raw beef, and where the exposure is severe enough, he is frequntly incapacitated through temporary blindness. Anyone or all of these conditions are adequately taken care of through the use of an efficient screen or welding glass.

A glass to afford this protection cannot be just a colored glass or red, blue, green, the combination which in the past was frequently used, or of a single glass of a light or dark shade. Density or depth of shade in a welding glass merely reduces the high visible light affording the operator a greater opportunity to observe the details of his work and is controlled largely by the individual sensitiveness of the eye.

It is through the reduction of this high visible light that the field of visible light transmission should be considered, for unless this field lies within the bands of the yellow green area of the spectrum, you do not provide the highest luminous efficiency for the welders and put upon them unnecessary eye strain. These factors combined with the physical aspects of the glass through freedom from waves, pits, and stria, are what might be termed the visual aspects of a good welding glass.

Combined with these factors are the unseen but all important points of high absorption efficiency particularly in the infra red ray. This is entirely controlled by the chemical composition of the glass itself and is determined through the use of laboratory instruments. Investigation on the part of the National Bureau of Standards recently indicated that thrugh a welding glass of a good filtering medium the infra red ray could be entirely eliminated.

Glass is now available which does not permit injury causing rays to reach the eyes of welders in both gas welding and electric welding from the carbon arc, to the atomic process, and the hazard of high temperature welding to the workman's eyes has thereby been eliminated.—(Reprinted from *Safety Engineering.*)

**Safety Engineer, American Optical Co.*

Welding in the West

Industries in the Far Western States Have Created a Demand for Methods and Equipment Which Are Being Utilized Throughout the World

By Miles C. Smith*

WHEN one mentions, "Far-Western Industry," many who have never been afforded the opportunity of seeing for themselves, can scarcely realize its existence. Yet as far as welding is concerned, the entire world owes much to the far West for its present day practices. In the future this promises to be even more noticeable, for developments are now in progress in the far West which cannot but revolutionize the manufacturing procedure in many industries.

This sectional development is due largely to the classes of industry which are most prevalent in the states west of the Rocky Mountains. The mines, smelters and large hydro-electric developments with their high tension power lines, have been very fertile fields for the development in welding practice; but it is doubtful if even they would have been responsible for so marked a growth in welding procedure had it not been for petroleum drilling and allied industries. The petroleum industry requires and utilizes principles and practices quite unlike any other branch of industrial activity in the world today.

As oil was brought to the surface in quantities far greater than the capacities of any means of immediate consumption, it was necessary to provide storage, and huge tanks, at first fabricated by riveting but now welded, were erected. Then pipe lines to carry off both the oil itself and the natural gas flow of the oil wells were installed, and some of these pipe lines were more than a hundred miles in length, connecting the oil fields with either a distribution plant or a seaport. It is quite true that these far western pipe lines were not the first pipe lines to be installed in the United States but these pipe lines and these storage tanks were the first ones of a similar nature to be welded and it was on this work that pipe line and large storage tank welding practice was developed. From this experience and as a result of it, all-welded (both longitudinal and joint seams) pipe lines are being installed in the far West, which a few years ago would be considered entirely impractical. One pipe line, for example, will be approximately 96 miles in length and part of its diameter will be 60" and then graduate down to 36", all made of sheet steel up to 5/8" wall thickness and with longitudinal seams arc welded on an automatic machine while the field seams are gas welded. This particular pipe line is for the conducting of water rather than oil or gas and must withstand a relatively high pressure per square inch.

Two factors in particular have influenced welding development along the Pacific Coast, but both of them might be classed as necessity. Out there operations are far away from the source of supply of materials and welding made it possible to buy stock lengths and stock sizes which could be cut to size and welded together on the ground. The other factor which aided in the adoption of welding is the necessity for speed in fabrication. Particularly in the petroleum industry speed in erection and installation is the all-important factor because a day or even an hour's delay may result in a loss of thousands of dollars. In maintenance speed is even more essential and for this reason fabrication by welding readily paves the way for repairs with the torch or electric arc.

So out in the oil fields, many of them far away from any other center of industrial activity, welders tried this and tried that from sheer necessity and found and developed the practices which have later become accepted as the proper ones to be adopted. The welding torch became the all-important device for both installation and maintenance. They pioneered and later the other industries copied and eventually practiced.

Of much greater importance even than the practicability of pipe line welding was a still more startling development which grew out of the oil field maintenance work and now threatens to revolutionize mechanical and machine fabriction. It is the opportunity to originate and try out under many different conditions, the practice of overlaying a steel surface subject to abrasive wear, by the application of an abrasive resisting alloy with the gas torch or the electric arc. For this particular operation, the oil field tools present an ideal subject and the service to which oil field tools are subjected in the rotary method of drilling gives every opportunity for demonstration.

A few years ago oil well drilling tools which became worn in service were reforged to their former dimensions. Then the practice of welding on metal to replace that which had been worn away, was tried and found satisfactory. This method was less expensive and required less time to perform than the reforging but it in no way resisted the wearing away of the metal so repairs were necessary just as frequently.

There is much discussion about just who was the first to suggest that if a metal of harder and more abrasive resisting qualities be welded on, instead of the ordinary steel rod then used, the results would be more satisfactory. A great part of the pioneering was done by The Stoody Brothers who maintained a job welding shop at Whittier, California, and specialized in the repairs of oil field tools and equipment. They had followed a similar practice to a small extent in the repairs of farm implements before oil was discovered in their vicinity and readily realized the possibilities. At that time Stellite had been developed and every effort was being made to perfect its use in oil field practice. The Stoody Brothers made rapid progress with their experiments and eventually developed a welding rod which they felt best met the requirements of the oil field industry. Shipments of it are now being made to oil fields in every part of the world.

From this struggling effort an industry has sprung which threatens to make many changes in machine design and construction. Aside from The Haynes Stellite Company, who market to the oil fields, and The Stoody Company, an outgrowth of The Stoody Brothers, there are in Southern California alone three thriving manufacturers of hard-surfacing material and many more are experimenting. Now the manufacturers of oil drilling equipment do not wait for worn parts to be replaced with abrasion resisting material but instead they weld on the hard surface where required before the tools ever go into service. And all this has happened in the space of just a few, as a matter of fact less than five, years.

Naturally this success of hard facing with abrasive resisting metal which may be applied by welding is being broadcast in all directions and inquiries are coming to all manufacturers of such material asking for suggestions relative to this and that service where steel parts are subjected to excessive wear. At the present time, aside from the petroleum industry, little actual practical data may be gathered but the trend is toward the adoption of this practice and little by little the resistance against its adoption is

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*Western Representative of The Welding Engineer.

being worn down. The one fact alone that this method has made possible the drilling of oil wells of from 5,000 to 8,000 feet in depth in less time than it formerly required to drill half that depth is a proven demonstration which cannot be overloked. And where steel will withstand the abrasion of rock and mineral in the earth's crust it certainly should withstand a similar abrasion under other circumstances.

In the matter of equipment, again the far West is pioneering to meet its own requirements. The oxy-acetylene outfit lends itself to portability but out there the electric-arc is being utilized extensively and through the character of the industries and work at hand the outfit must go to the work rather than the work go to the outfit. This condition has stimulated the development of portable electric outfits which are easily transported and sufficiently large in capacity to be utilized when they are on the job. For the most part the work is heavy and fast. Equipment which has been pronounced fully adequate elsewhere, fails to meet the requirements and so, as in the instance of the hard facing metal, experiments are going on locally to develop equipment which will fulfill them.

So sheer necessity and the location of mineral deposits have been responsible for a field of development in welding which never existed before and perhaps never will exist again. Mass production requires automatic machinery but where instead of mass production the welder is confronted with thickness of materials and diversity of operations combined with a call for speed, technique and skill as well as inventive genius, welding operators have come into their own and are setting a pace for the rest of the world to follow.

PROJECTION WELDING IS A COMING ART

By G. N. Sieger*

Although it is conceded that in a great many plants where spot welding machines are used there is not much necessity for worrying about the quality of the weld, it is never the less regrettable that the possibilities of spot welding are often judged by the quality of work done in shops where there is no attempt to do anything more than stick the metal together. Excellent work can be done and is done on all of these standard commercial type spot welders. Indications are, however, that a great many operations now performed on spot welding machines will in the future be done by the projection welding method. There have been so many improvements in the technique of projection welding and in the design of machines and electrodes for this work during the past few years, that it is altogether unreasonable to judge projection welding by the work which was done several years ago, when it was still in the experimental stage. Projection welding is the ideal process in a great many cases because it makes it possible to concentrate the welding heat, right at the start, directly between the surfaces of metal to be joined. Without projection, if the stock should happen to be clean at the surfaces of the joint and rather dirty on the surfaces which contact with the electrode, the heat is more apt to start from the outside and have to work in, resulting in a waste of power and either the use of too much heat or not enough heat to get a good joint. The projection method looks like the only logical solution of these difficulties. It is being adaped by a great many metal working factories who have given it a through investigation during the last few years, and wherever careful attention has been given to the design of the equipment and the technique of operation the result has been uniformly successful and satisfactory. The process has much promise of further development and the welding industry may look forward to some interesting improvements in this process in coming years.

Vice President, Elkon Works, Inc., Weehawken, N. J.

SILVER SOLDERING EFFECTIVE METHOD OF JOINING SMALL PARTS

Where small parts of either steel or bronze are to be joined and where greater strength is required in the union than is possible with ordinary solder, silver solder forms a joint that possesses considerable strength even at high temperatures. For this reason it is used extensively in the manufacture of welding and cutting torches. Another important characteristic of silver solder is its remarkable penetration, finding its way into the tightest mechanical joints, and giving a perfectly fused union.

Silver solder is a hard solder which consists of silver, copper, zinc or brass, the exact composition depending upon the nature of the work. The Silversmith's Handbook gives the following table:

Remarks on use	*Parts of Silver*	*Parts of Spring Brass*	*Parts of Copper*	*Parts of Zinc*
Jewelers' Hardest	4	.....	1	....
Hard	16	.....	3.5	0.5
Easy	14	.....	4.5	1.5
Common Hard	12.5	.....	6	1.5
Common Easy	11.5	.....	6.5	2
Easy for chains	10	5	....	1
For Steel	18-19	2-3	1	....
Brass, gun metal, bronze	1	1	....	....
Brass, gun metal, bronze	1	.....	8	8
German silver, gun metal, bronze	3	.....	2	4
German silver, gun metal, bronze	5	6	....	2
Brass, small articles	2	.....	5	3
Jewelers' instrument makers, very tough and fluid	11	.....	13	....

The usual welding procedure cannot be followed in using this method as it is very easy to apply too much heat, thus burning the solder and leaving a porous deposit of little strength, at the same time injuring other properties.

The proper method is to clean thoroughly the parts to be joined with emery cloth or grinding, and heat to a bright cherry red, but not to a sweat. Use the brush of the flame, never the cone, so as to bring the metal gradually to an even heat all the way through. If the parts are heated only on the surface, poor fusion will result. The metal must be at, but very little above, the melting point of the solder, and then, after applying an ample quantity of soldering flux or borax to both the silver and the parts, place the solder in contact with the metal, using only the brush of the flame to apply slightly more heat if small spots remain where the solder does not flow freely, and allowing to cool as soon as proper penetration is assured. If parts are clean, this is no more difficult an operation than using soft solder.

The silver solder hardens very quickly and it is this property of retaining its full strength to within a comparatively few degrees of its melting point that adds considerably to its usefulness in many special applications.

In silver soldering a band saw or other flat object, a different method must be used. The ends of the saw must be bevelled so as to make a lap joint, the bevel being as long as the width of the saw or slightly longer. They must be supported by suitable means to keep them in line while soldering, allowing a space between the supports where the heat is applied. When the saw ends are properly placed, in position, a piece of solder foil, the size of the joint, is placed between the bevelled pieces and borax is applied. A clamp made of a piece of band iron formed into a ring, is sprung apart and slipped on the joint to hold the pieces together, and held firmly until cold. The actual operation of soldering should be done in a few minutes. The oxy-acetylene flame is too hot unless a small size tip is used and is held some distance away. Overheating can thus be avoided and successful results obtained.

Welding Industrial Buildings

Some Experience Gained in Constructing the Arc-Welded Steel Factory Building of the West Philadelphia Works of the General Electric Co.

By Frank P. McKibben*

IN THE construction of the arc-welded factory building recently completed at the General Electric Company's West Philadelphia Works several interesting problems were encountered and solved. Among them may be mentioned:

Building Codes

Securing a building permit from the Philadelphia Bureau of Building Inspection. In Pennsylvania a legislative act of May 5, 1899, prescribed a building code applicable to cities of the first class which thus far affects Philadelphia only. This code has been supplemented from time to time by legislative acts, by municipal ordinances and by regulations issued by the Philadelphia Bureau of Building Inspection. In the present instance, the Bureau adopted a brief but sufficient regulation under which this welded structure was designed and built.

In this connection, it may be interesting to point out the very essential differences in building codes so far as permitting new materials or new types of construction are concerned.

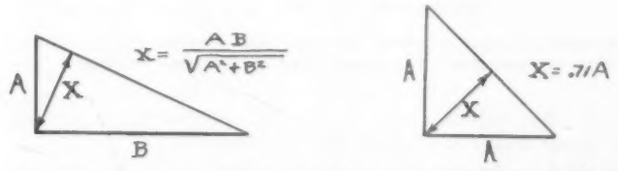


Fig. 1—Cross Sections of Triangular Fillets Showing Minimum Shearing Sections, X.

In some cities codes not only specify certain definite types, thus excluding all others, but contain no authorization, either by implication or by specific mention, of a power vested in the administrative bureau to permit new types and new materials even after investigations of the bureau show these to be proper and safe. This kind of a code, especially when municipal ordinances are based on legislative acts, is very difficult to change, exercises a hardship on manufacturers and builders of new materials and often penalizes tax payers by prohibiting the use of newer, better and more economical types of construction. Law is a reflection of public opinion. It is not the cause. Such being the case, when a legislative act imposes a code on a city or when the municipality adopts a code without provision of flexibility, the effect as new modes of construction appear, is either to exclude them or to compel the administrative bureau to violate the ordinance by granting permits.

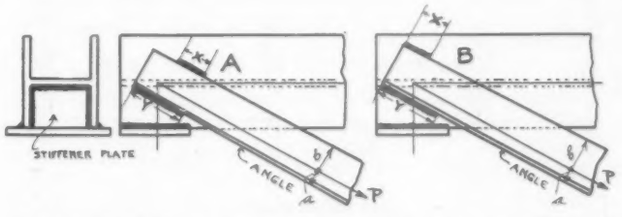


Fig. 2—Connecting an Angle to a Top Chord of a Truss. Illustrating Unsymmetrical Distribution of Fillets on Account of Unsymmetrical Section of the Angle.

Other cities include in their codes a section which authorizes the administrators to grant permits for new types after proper and satisfactory investigation thereof. This opens the way to certain abuses perhaps but on the whole works well. For example, reinforced concrete buildings were constructed under permits several years before the Pennsylvania legislative act was changed to recognize this type of building which is now one of the standard forms. When public opinion was sufficiently crystallized to demand a change in the law the act was amended accordingly.

The following section is quoted from a building code to illustrate a flexibility surrounded with sufficient safeguards:

"Whenever it is desired to use new materials or materials not specified in this Code, application therefor shall be made to the Board of Building Commissioners in writing, stating in detail the materials and the manner of construction in which they are to be so used. The person or persons seeking to use such new materials shall give to the said Board upon its request therefor, such information and tests in connection with the nature and use of such proposed new materials, as the said Board may require."

Fillet Welds

In designing a welded structure the type and strength of the welded joint must be considered. Here we have a choice of butt welded joints in which tension or compression is the predominating stress, or lap welded joints; (a) wherein the fillet weld is deposited along the sides of one of the connecting pieces thus subjecting the fillets to longitudinal shear parallel to the line of stress, i.e., parallel to the axis of the member; or (b) wherein the deposited fillet is laid across the end, transversely to axis of the piece and at right angles to the stress, thus subjecting the fillet to a shear different in manner from that under (a); or (c) wherein the connection is made by combining the side and end welding of (a) and (b).

Interior of northerly aisle of West Philadelphia building during construction. Welded roof trusses near top of picture.

In the West Philadelphia building, butt welds were avoided wherever possible, and most of the members were connected by fillet welds, described under (a) above. In this case the safe unit longitudinal shear allowed on the fillet was 11300 pounds per sq. in. of minimum section X, Fig. 1. And since the base and altitude of the section of the fillet are generally equal the minimum section X equals .71A, Fig. 1. Thus for a ⅜ fillet, i.e., ⅜" base and ⅜" altitude, X = .71 (.375) = .266",

Consulting Engineer, Black Gap, Pa.

TABLE I

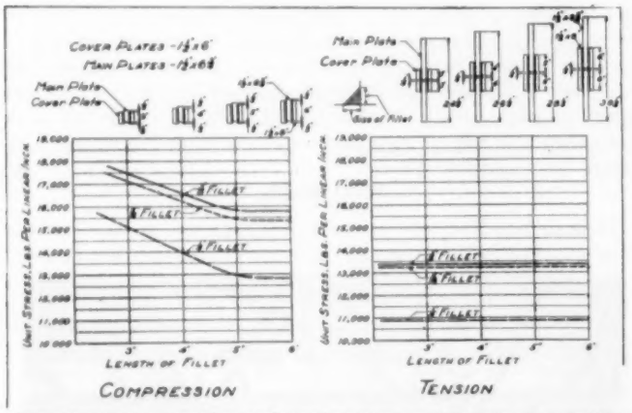
Safe Allowable Shearing Strength for Triangular Fillets at 11,300 pounds per square inch.

A* In.	B* In.	X* In.	Safe Strength per Linear Inch of Fillet. Lbs.
½	½	0.355	4,000
⅜	⅜	0.266	3,000
¼	¼	0.177	2,000

*See Fig. 1.

and the safe unit shear per linear inch of fillet is .266 times 11300 = 3000 lbs., Fig. I and Table I.

Table I shows safe allowable unit stresses for static loads. For structures subjected to impact, as for example crane runways, the live load stresses must be reduced to equivalent static stresses before values in Table I are applicable. With a table of permissible unit stresses at hand the required number of linear inches of fillet to carry a given stress from one member to another is readily obtained by dividing the stress by the unit value of the fillet per linear inch. In actually laying out this on the drawing the number of linear inches of fillet must be arranged symmetrically about



Summary of compression and tension tests to determine longitudinal shearing strength of ¼, ⅜ and ⅝ inch triangular fillets.

the axis for members having symmetrical cross sections. Thus, if a stress of 40000 lbs. is to be transmitted by a ½" fillet at 4000 per linear inch, 10 linear inches are required, or 5 linear inches on each side of the axis of stress. But if the member being connected have an unsymmetrical section like an angle the 10 linear inches should be arranged unsymmetrically with the longer part of the fillet along the back of the angle, Fig. 2.

Thus, Fig. 2, the length Y of fillet $= \frac{Pb}{(a+b)f}$

and $X = \frac{Pa}{(a+b)f}$ P = tension in one angle.

f = safe unit strength of fillet per linear inch.

For a 6" x 4" x $\frac{7}{16}$" angle having tension of 40000 lbs., ½" fillet $Y = \frac{40000\ (4.04)}{6\ (4000)} = 6.7"$; and ½" fillet $X = \frac{40000\ (1.96)}{6\ (4000)} = 3.3"$; and of course X + Y = 10", or $\frac{40000}{4000}$

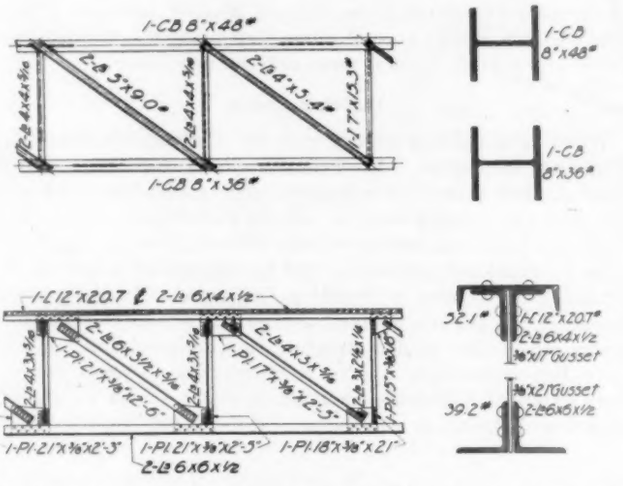
Now at first thought the arrangement at B, Fig. 2, would be adopted, but is not arrangement A better?

The values herein used have a factor of safety of four for welds properly made.

The use of butt joints is preferably confined to secondary members.

Competency of Welders

The third interesting problem is a competency test for welders. Before a welder should be allowed to work an important structure he should be tested to ascertain his ability to weld butt joints; lap welds with fillets; welds on flat, vertical and "overhead" surfaces, if any of the latter be used in the construction; his ability to select the proper current and diameter of electrode for a given thickness of metal, to hold a steady short arc, to secure penetration not only in each edge of the two plates being welded with a fillet weld but also at their line of contact, to deposit fillets free from gas both along the surface of the fillet and in the crater, to avoid rounded edges on fillets which indicate lack of penetration. The welder's competency is best determined by tension tests and by wedging apart

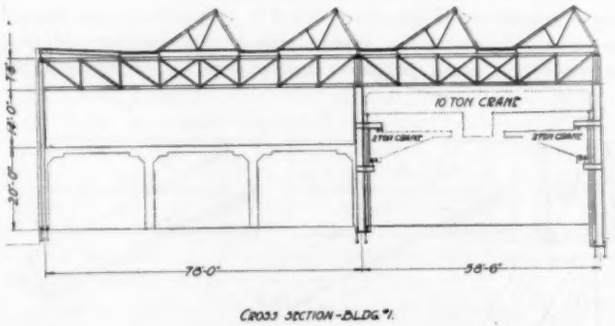


Portions of proposed riveted roof truss and adopted welded truss with sections of upper and lower chords, West Philadelphia building.

sample lap welded plates, but in fairness to the welder the minimum length of fillet should be at least 5".

Steel to Be Clean

So far as shopwork is concerned, we must first remember that the best welds are secured on clean steel. Rust, dirt and paint should be removed from steel to be welded. And it is probable that this requirement will result in better protection of steel before being used because the fabricating shop will find it pays to protect the steel against undue rust rather than to clean



Typical cross section of West Philadelphia welded building.

it after rusting. Experience shows that steel must be free from paint both in the shop and at the site of erection, but that steel coated with linseed oil is as easily welded as clean steel. This means that we must weld clean steel in the shop, give it a coat of oil before shipment, erect it, then finally paint it, after—not before—the field welding is accomplished.

Assembling Steel in Shop

It should be remembered that on account of the higher cost of field welds as compared with shop welds, designs should be arranged to use as few field welds as possible.

Again, the cost of shop work can be very much reduced by

the use of jigs wherever possible; and by the use of automatic welding machines. In columns, plate girders, and in longitudinal seams of tanks, automatic welding machines with two welding heads side by side for girders and in tandem for pipe work, are useful and necessary for economical production. But for ordinary truss work, for light roofs, or for small details on columns, hand welding thus far is found to be most practicable.

In shop assembling, bolts are seldom necessary. Clamps are cheaper and quicker, and if designs can be arranged to avoid punching or other shop work on steel, so that beams, chan-

Wall crane bracket being welded to main columns.

nels, etc., can be sent directly from the mill to the erection site, a considerable saving in costs will result.

Field Welding

In field erection, just sufficient bolts are necessary to line up the steel and to hold the parts together until welded. To attempt to erect a building of any size without bolts is a waste of money, and if bolts of proper "grips" be used they can be left in place. For field welding, single operator motor generator sets are convenient, especially if mounted on small trucks to permit the sets to be moved and kept fairly close to the welder.

Current Values

Care must be taken to vary the current, depending on the diameter of the electrodes and on the thickness of parts being welded. For example, a current of 175 amperes with a $\frac{5}{32}$" electrode will give good results for plates $\frac{3}{8}$" in thickness, but may burn through plates of only $\frac{3}{16}$" thick.

West Philadelphia Welded Building

The West Philadelphia welded building of the General Electric Company, containing nearly 989 tons of steel, consists of a headhouse 171 ft. long, 78 feet wide with a vertical clearance of 43 feet; of two aisles at right angles to the headhouse, one 59 feet wide by 474 feet long, the other 79 feet wide and 474 feet long. These aisles and the headhouse comprise a building approximately 138 feet wide by 552 feet long covering a ground area of about 80,150 sq. ft.

As this structure will be used for arc welding steel tanks it is appropriate that it be arc-welded throughout.

Ten-ton bridge cranes operate on 73 feet 5½-inch and 59 foot spans in the headhouse and one main aisle respectively. And one 5-ton bridge crane serves one end of one aisle on a span of 46 feet 2 inches. In addition provision is made for several 2-ton wall cranes.

The steel was fabricated at the welding shop of the American Bridge Company at Trenton, N. J.

For the American Bridge Company, J. H. Edwards, Chief Engineer, had charge of this structure. For the General Electric Company the writer was consulting engineer, cooperating with William Dalton of the company's plant engineering department. Harris & Richards, Philadelphia, were the architects and the U. G. I. Contracting Company, Philadelphia, was general contractor.

ALFRED DE FOREST, RESEARCH ENGINEER, WINS DUDLEY HONOR PRIZE

Alfred V. de Forest, research engineer for the American Chain Company, was recently honored by the National Society for Testing Materials which organization awarded him the Dudley National Medal in recognition of his achievement in perfecting the non-destructive test for materials. With the device Mr. de Forest has developed it is now practical for any young woman to sit in front of a machine and by means of a graph on which appears a hysteresis loop determine instantly whether or not the material passing in front of her has the slightest defect.

Magnetic analysis is a subject on which dozens of eminent re-

Alfred V. deForest

search engineers have been working for years. Now the problem is solved through Mr. de Forest's sensitive electric galvanometer which will detect a flaw no bigger than a pin-head in the center of a large steel wheel, and all without cutting or marring the surface of the metal.

In operation, the galvanometer is comparable to the x-ray which penetrates the tissues of the human body without harming them. With the newly developed instrument a plate or piece of steel five or six inches thick may be explored almost as though it were made of glass.

This invention will have a far-reaching effect on the quality of all materials used in industrial machinery. As an instance, just one of the important uses to which it may be applied is the inspection of steam turbine wheels. Such wheels with their buckets frequently operate at speeds upwards to 3,600 revolutions per minute, and should a flaw deep in the center of the steel of which they are made cause a section to fail, the resulting destruction would be terriffic. Countless others, and equally important, applications await its production.

Mr. de Forest graduated from Massachusetts Institute of Technology in naval architecture in 1912. He was with the New London Ship and Engine Company for one year, after which he became instructor in civil engineering at Princeton. He later studied metallography at Columbia, then spent two years in the research department of the Remington Arms Union Metallic Cartridge Company. Since 1918 he has been chief research engineer for the American Chain Company, his activities extending to the products of all the American Chain associate companies, such as the American Cable Company, Page Steel & Wire Company, Manley Equipment Company, Reading Steel Casting Company, Dominion Chain Company, and others.

Dr. W. H. Hatfield, director of the Brown-Firth Research Laboratories, Sheffield, England, will deliver the Campbell Memorial Lecture during the annual convention of the American Society for Steel Treating in the Week of Oct. 8 at Philadelphia. His subject will be "The Application of Science to the Steel Industry."

WELDING PROVIDES ALL-AROUND IMPROVEMENT IN PRESS BRAKE CONSTRUCTION

One necessary piece of equipment in every plant using sheet metal is the press brake, used for forming the sheets or for multiple punching. Until the last four or five years all brakes were constructed of massive castings of iron or steel, until The Cincinnati Shaper Co. began to build their brakes of welded steel plates.

Being subjected to such heavy duty, and frequently to overloads, breakage of these castings was a serious factor, not only in replacement costs but sometimes even more in the cost of shutdowns of the machines. That the new welded brakes have solved the breakage problem is evidenced by the growing popularity of this type of construction.

Fig. 1. End Housing Plate Cut With Torch.

The first step in the building of these brakes is cutting the plates to the proper shapes, including holes for bearing boxes, etc., with the torch, using natural gas and oxygen. After cutting, the plates are machined. One of the end housing plates, before machining, is shown in Figure 1.

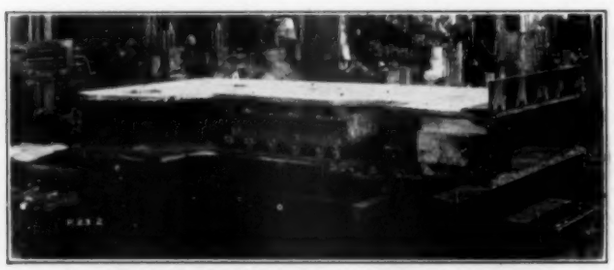


Fig. 2. Welded Construction of End Housing.

To provide housings of the necessary strength, they are built up as shown in Figure 3. The plates are first welded, and then drawn together with taper pins, bolts and rivets, resulting in a solid, rigid housing. To add still greater strength and rigidity at the points where stresses occur, angle iron braces and other rolled shapes are welded in. Figure 2 shows the solid construction obtained by this means with a minimum of metal.

Where bolts are used in these members to draw the plates into place, the bolts themselves are welded as well as the plates, so that they become an integral part of the member with no chance of working loose. This construction affords permanence and exactness of alignment.

The compactness of these machines, which is evident in Figure 4 showing the completed brake, possesses advantages other than those already mentioned. The question of deflection in securing perfect bends is eliminated; greater capacity is provided; limitations are removed on the width of material that can be handled; the weight is considerably reduced for any given capacity, thus cutting transportation costs and simplifying the work of erection.

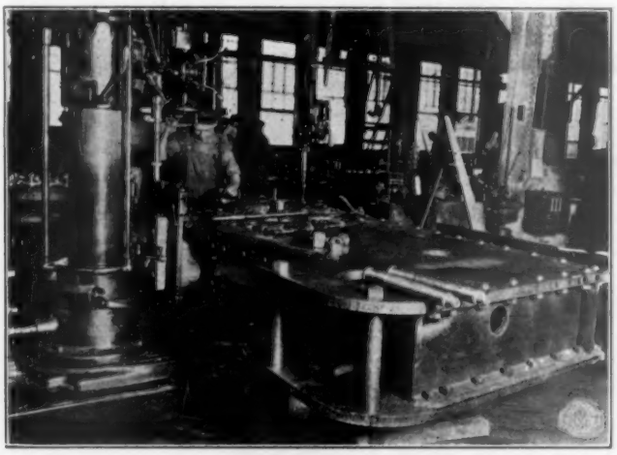


Fig. 3. Where Bolts and Pins Are Used, They Are Welded to the Plates.

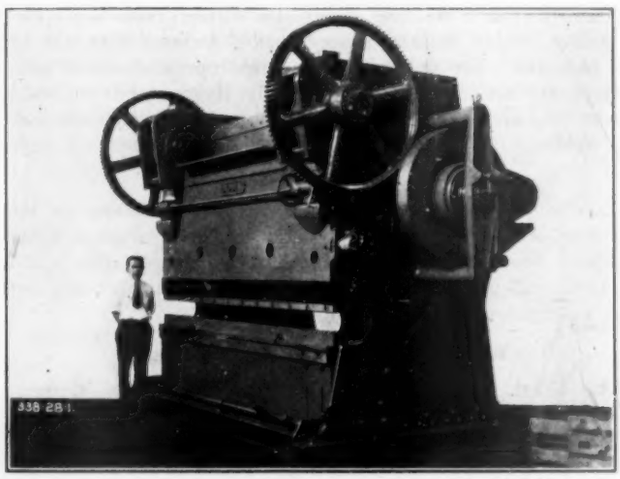


Fig. 4. These Welded Steel Brakes Are Strong, Rigid, and Compact.

These brakes furnish an excellent example of the principle of complete redesign as employed increasingly by manufacturers of heavy machinery who are willing to throw old designs into the discard in order to avail themselves of all of the advantages offered by welded construction.

AMMETER CAN BE USED TO RECORD CYCLE OF WELDING OPERATIONS

Use of recording and controlling instruments in the iron and steel industry was reviewed by C. C. Eagle and Roy M. Walker, Bristol Co., Waterbury, Conn., at the Chicago meeting of the Association of Iron and Steel Electrical Engineers. They said that the increasing use of arc welding has created a demand for an

instrument to record the cycle of operations and give a history of the work done by the welder. A recording shunt ammeter does this so well that it is regularly furnished with some welding machines. It gives a record of time worked by the welder, so that the faithful welder gets full credit for his work. The character of the curves shows the type of work. If a large stick or two sticks are used, instead of one, to rush the work, this is shown up by the excess current. Reversed polarity hastens the work and badly weakens the weld, and is unmistakably recorded on the chart. If an electrode is thrown on the ground and left there, the straight line curve shown on the chart indicates the grounding of the electrode. Reference to the chart is a help to the welder and enables the supervisor to correct irregularities.

(Editor's Note: As an illustration of the above, which is quoted from the Iron Age, the reader is referred to the chart included in H. L. Hagglund's article on underwater cutting in this issue.)

ELECTRIC ARC CUTTING AND WELDING CO. REVIEWS DEVELOPMENTS

A review of their accomplishments in the A. C. and D. C. welding fields has been received from the Electric Arc Cutting and Welding Company, manufacturers of the "Dualarc" welding generators and of the "Alternarc" transformer type welding and cutting apparatus.

A recent development is the use of the A. C. arc in cutting stainless steels and heat resisting steels and other alloys of exceptionally high melting point which cannot be cut by the oxy-acetylene flame. Considerable savings in time and labor are claimed particularly in the removing of gates and risers from castings made of these metals.

The "Dualarc" welder can supply either alternating current or direct current. The alternating current can be used for the operation of electric drills, grinders, drop lights, and for intermittent arc welding. These welders also have a separate control of voltage and amperage, giving a wide range of flexibility, and they will operate as either a compound or differentially wound generator. The manufacturers state that they have also produced the only combination direct motor-generator set and engine drive with clutch.

Other developments of this company were the self-propelled railway welding car in 1925, a tapered rod designed to give constant heat the full length of the electrode, and a special cutting electrode with a coating which liberates free oxygen at the temperature of the arc, burning away the metal and forming a liquid slag which alows cutting and hole boring.

This company also manufacturers a complete line of A. C. welders, sold under the name of "Alternarc".

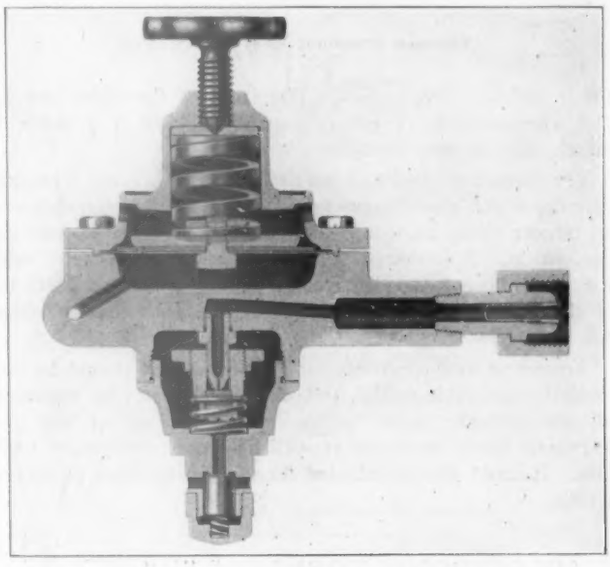
W. H. HULBERT RESIGNS THERMIT SALES MANAGERSHIP

W. R. Hulbert, Sales Manager of the Thermit Department of the Metal & Thermit Corpporation, has resigned in order to enter the firm of Thomas H. & Milan H. Hulbert in Chicago on August 1st. He will be located at No. 6 North Michigan Avenue. Mr. Hulbert was graduated from Columbia University in 1904 with the degree of Mechanical Engineer. He was then connected in succession with the Power & Mining Machinery Company, the Rand Drill Company (now the Ingersoll-Rand Company) and the Kobbe Company of New York. While with the latter company, he acted as Managing Editor of "Compressed Air" which was being published by them at that time. In 1907 he entered the employ of the Goldschmidt Thermit Company as Assistant Engineer. When the Metal & Thermit Corporation was formed in 1916 he was made Sales Manager of the Thermit Department.

John B. Tinnon has been appointed Manager of Sales of the Thermit Department of the Metal & Thermit Corporation, effective August 1st, succeeding Mr. Hulbert. Mr. Tinnon received his education at Vanderbilt University and entered the electric railway field in 1908 in the Engineering Department of the Chicago City Railway Company. He served as Assistant Engineer during the very extensive rehabilitation of the property and in 1912 was appointed Engineer of Way of the Chicago & Joliet Electric Railway Company, which position he occupied until 1918 when he served in the Ordance Department of the U. S. Army. In 1919 he returned to the Chicago & Joliet Electric Railway Company as Chief Engineer. In 1924 he became connected with the Metal & Thermit Corporation as Manager of the Rail Welding Department.

NEW TORCHWELD REGULATOR ANNOUNCED

A new style regulator just placed on the market by the Torchweld Equipment Company, Chicago, is featured as being sturdily built from brass forgings, and insuring correct regulation and control of the gases when welding or cutting, with positive safety. They have self-centering sensitive triple diaphragms which are interlocked in position between the regulator hood and body and have a simplified adjustment for keeping uniform tension on the diaphragms. Oxygen regulators of the new series have a positive safety relief valve which is automatic in operation and is fitted on the back cap of the regulator. This new oxygen regulator safety release valve can be put on all Torchweld oxygen regulators now in service. It does not contain a disc to be broken by excess pressure, but is a safety pressure valve. When oxygen pressure becomes excessive in the regulator body this safety valve releases the pressure down to a safe load. It is automatic and requires no attention by the operator.

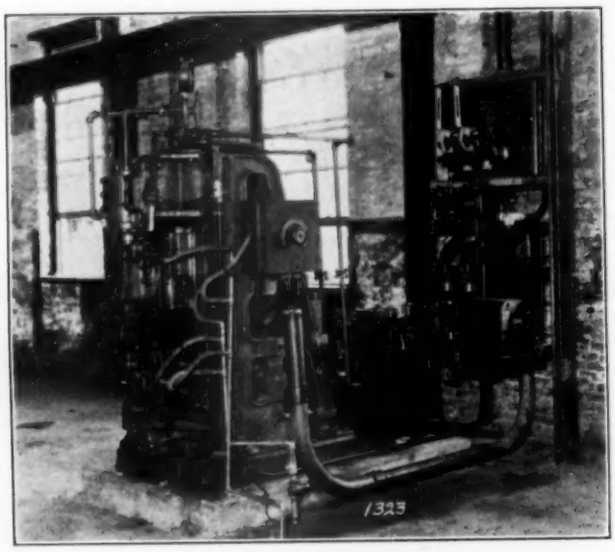


Torchweld Regulator With New Safety Relief Valve.

Most damage to oxygen regulators, namely the gauges, diaphragms and seats is caused by operators leaving the adjusting screw turned in when opening up the oxygen cylinder. It is a known fact that when this happens the seat is away from the nozzle and the tank pressure builds up into the body of the regulator before the regulator has a chance to close off; by this time the gauge has been damaged, the diaphragm buckled or warped, the seat cracked or pitted. The Torchweld new safety release valve protects these parts by taking off the load when the pressure gets too high.

HEAVY DUTY SPOT WELDER FOR STRUCTURAL WORK

A new spot welder designed especially for structural steel welding has been produced by the Thomson Electric Welding Company, Lynn, Mass. This machine, known as Model 40-AV, has a throat depth of 12" from the outermost edge of slides to frame of welder, or 8½" from frame to center line of pressure. The slides are made of cast copper and water cooled. Lower slide has a vertical adjustment of 4 inches, and the maximum distance between the upper and



Thomson Structural Steel Spot Welder.

lower slides is 10½ inches. The faces of the slides are flat and approximately 7 inches square, making it possible to attach dies to suit conditions.

The pressure device consists of a 14-sq. in. hydraulic cylinder which may be connected either to an accumulator or an oilgear pump capable of delivering a pressure of 1000 lbs. per. sq. in. A four-way manually controlled hydraulic valve for controlling hydraulic system supply is mounted on top of the welder with suitable control level conveniently placed for the operator.

According to the manufacturers, this welder should be particularly applicable to the spot welding of plates or structural shapes not over ½ in. or 5/8 in. in thickness, or any part requiring heavy pressures as well as large transformer capacity. It could also be adapted for making multiple projection welds.

"ELECTRONIC TORNADO" SUBJECT OF LINCOLN BULLETIN

A bulletin describing the "Electronic Tornado" method of welding in all its phases, including a treatise on the comparative advantages of the use of the carbon electrode and of the metallic electrode for automatic arc welding, has recently been issued by The Lincoln Electric Company.

Entitled, "Automatic Arc Welding by the Electronic Tornado Process," the text deals first with the strength and ductility and metal structure of the welds made by the new process. It continues with a description of the operation and a table showing the speed and costs of automatic arc welding of metal of different thicknesses for various joints. Illustrations of automatic welding machines showing actual application of the new process are also included.

The "Electronic Tornado" is a development by the Lincoln Electric Company of the automatic carbon arc method of welding, utilizing a newly discovered method for controlling and localizing the heat of the arc.

TWO NEW BULLETINS BY FUSION WELDING CORPORATION

The following from the "Foreword" of Bulletin No. 128 explains the purpose of a series of bulletins which have been prepared by the Fusion Welding Corporation, 103rd Street and Torrence Avenue, Chicago:

"Published . . . . . for the purpose of giving a better understanding of some of the phases of welding which are obscure and on which there have been many different opinions. The analysis of welding rods, for example, has been widely discussed but few welders know what the actual significance of the elements mentioned in welding rod specifications really is. It is the purpose of these bulletins to discuss in non-technical language the effects that carbon, manganese, etc., have on the flow of welding metal, and the resulting deposits, and thereby to promote a better knowledge of the welding processes. The first element to be discussed is carbon."

Another bulletin has been issued describing the complete Fuzon line of motor-driven and gas engine-driven welders. Welders, plant superintendents and engineers who are interested can rereive these bulletins regularly by registering their names with the Research Department of the Fusion Welding Corporation.

LINDE PUBLISHES BOOKLET ON INDUSTRIAL PIPING

The Linde Air Products Company have published a booklet called "Oxwelded Industrial Piping," which describes and explains clearly economies in construction, repair and maintenance of oxy-acetylene welded pipe systems, and is profusely illustrated with cuts showing typical pipe installations for steam, water, air, gas and oil.

The advantages of welded joints for any system, from the standpoint of economy and efficiency in construction, maintenance, and operation, are sketched convincingly. This booklet may be obtained by addressing the above company at Room 401, 30 East 42nd St., New York, N. Y.

COMPLETE CATALOG OF OXWELD WELDING AND CUTTING EQUIPMENT

A new 56-page catalog has just been issued by the Oxweld Acetylene Company which describes in detail products manufactured by this concern, including welding and cutting equipment of all sorts, and generators for the production of acetylene. New items described in this edition are the new type C-14 cutting blowpipe, the Carbic portable low-pressure acetylene generators and the Carbic floodlights. Included also are gauges, regulators, and stationary and portable regulators.

CARBIC FLOOD LIGHT DESCRIBED IN NEW BOOKLET

To illustrate the many uses to which a portable acetylene flood light can be put, in the building, mining, railroad and other industries, the Oxweld Acetylene Company have put out a little booklet describing the Carbic Light, and suggesting numerous ways in which this flood light can be used to advantage wherever oprations are carried on at night.

LARGE CAPACITY KEROSENE TORCH

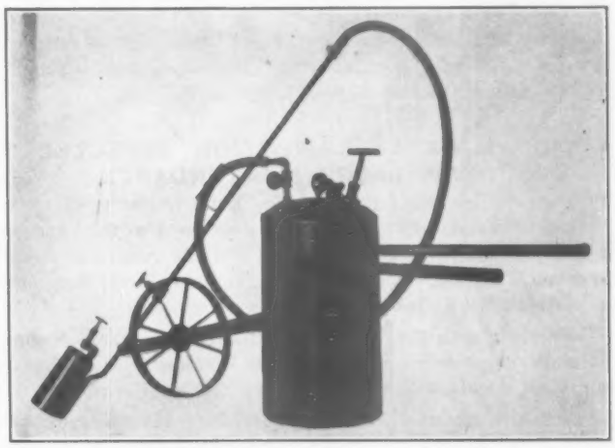
Increasing use of kerosene torches in a multitude of industrial, railway and highway services has resulted in production of these torches with large capacity tanks which are too heavy for one-man operation.

To avoid necessity for the employment of two men in using such kerosene burners, the Chausse Oil Burner Company of Elkhart, Indiana, has announced a model arranged similarly to a

wheelbarrow. This outfit can be easily transported by the man who requires it in his occupation.

A conventional type welded steel tank with capacity of 14 gallons of kerosene is mounted in tubular steel shafts with a single wheel. To the tank, which has a self contained air pump and pressure guage, is attached the kerosene burner by means of heavy duty pneumatic tool hose. The burner handle is steel, with wooden grip and convenient needle valve.

This burner is self generating and produces a heat temperature



Chausse Oil Burner With Large Tank.

from 1750 to 1800 degrees, F. The volume of gas is considerable and makes this outfit adaptable to such work as pre-heating prior to welding, thawing frozen piping, melting snow on tracks and switches, and wherever an intensely hot voluminous flame is desired.

SERIES OF BULLETINS DESCRIBE GENERAL ELECTRIC WELDERS

General Electric Company have announced a new automatic welding head and control, with an electrode feeding device of the magnetic clutch type. This unit is available either separately or as a part of a complete automatic welding equipment. Apparatus of this type is of particular value in the construction of standard products, such as pipes, tanks, boilers, cans, automobile rear-axle housings, car wheel flanges, and shafts, or wherever a welding operation is repeated as a part of mass production schedule. This equipment is described in Bulletin G E A—556 A.

Bulletin GEA—1031 illustrates and describes the Type A W Resistor Arc Welders. When a constant potential source of supply is used to furnish welding current, a variable resistor is required to obtain the desired current values and to consume the excess voltage represented by the difference in voltage between the supply circuit and that required to maintain the arc. Various stationary and portable mountings of these resistors are provided, with accessories for mine, electric railway, and other duty.

General Electric Company have also recently issued two attractive and interesting 30-page booklets, one entitled "Arc Welding in G. E. Factories," which illustrates a considerable variety of applications of arc welding in maintenance, and particularly in production of stator frames, rotor spiders, girders, oil switches and transformers, piping and machine bases and frames. The other booklet, entitled "Arc Welding in Industry," describes in similar fashion numerous uses to which arc welding is put in all of the principal industries.

STURCKE "OVERFLOW" JACKET DESCRIBED IN BOOKLET

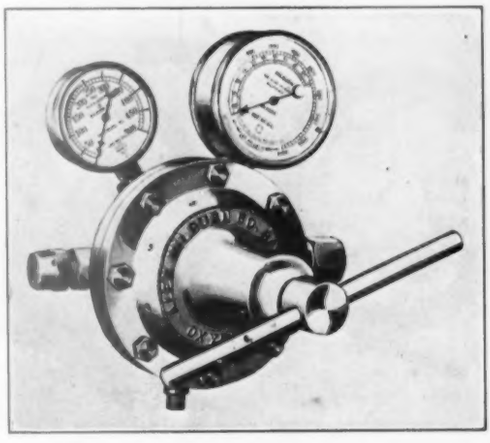
A booklet has just been issued describing the Stürcke "Overflow" Jacket for the accurate testing of cylinders for compressed gases, by Chas. L. Gulick, General Sales Agent, 110 East 42nd Street, New York City.

The origin, operation and results secured from use of the "Overflow" Jacket are set forth. The apparatus permits accurate expansion tests under ideal pressure conditions, and in a most practical manner; there is a constant pressure in the jacket during the entire test. It is the result of experiments made because of realization of the need of a more accurate method of ascertaining the volumetric elastic expansion of cylinders. In testing, a water jacket is used but instead of forcing the water displaced by the cylinder expansion to rise in a glass indicator and produce added pressure, the displaced water is allowed to overflow into a graduated glass tube, thus permitting a constant pressure in the jacket. By this simple modification all the errors due to the rising water column are eliminated. If the temperature in the jacket remains reasonably constant during a test, the presence of air in the jacket does not affect the test result; neither does the method of fastening the cover or the strength of same. The operation of the new method is as simple as that of the old jacket. The great merit of the overflow method is that the results obtained are dependable. The manufacturers declare that the test is far superior for ascertaining the beginning and the amount of plastic expansion, facts closely allied to the elastic expansion in judging the quality and safety of a cylinder.

MILBURN "SUPER MASTER" REGULATOR

The new Milburn "Super Master" Regulator has been designated to supply the demand for a regulator for use in operations where a large volume of gas or a great number of outlets are to be controlled.

The manufacturers declare that its sturdiness assures it of long life even under the most strenuous usage, and that it affords protection to the line and other apparatus even should mishandling or accident result in sudden additional and violent pressures. In addition to its strength, however,



Milburn "Super-Master" Regulator.

it responds to the needs of the most delicate operations as well as the heaviest.

The bonnet is of sturdy bolted construction. An added feature is a safety blow-off valve. The diaphram extends to the outer circumference of the regulator and is secured by the same bolts which secure the bonnet. The "Super Master" Regulator is equipped with 3000 pound initial gauges and 500 pound delivery gauges.

The floating operating pin is of monel metal which combines high resistance to oxidation and corrosion with a tensile strength greater than mild steel. The diaphram is of a special bronze, extremely resilient and with high corrosion resistance. An eight inch heavy steel key affords ample leverage for the highest pressures.

Accessibility is another feature of the Milburn "Super Master" Regulator. The user can reach the seat of the Regulator without disconnecting it from bottle or hose. The main operating parts comprise only pin, nozzle and seat-

carrying sleeve and are immediately available for examination, cleaning or removal.

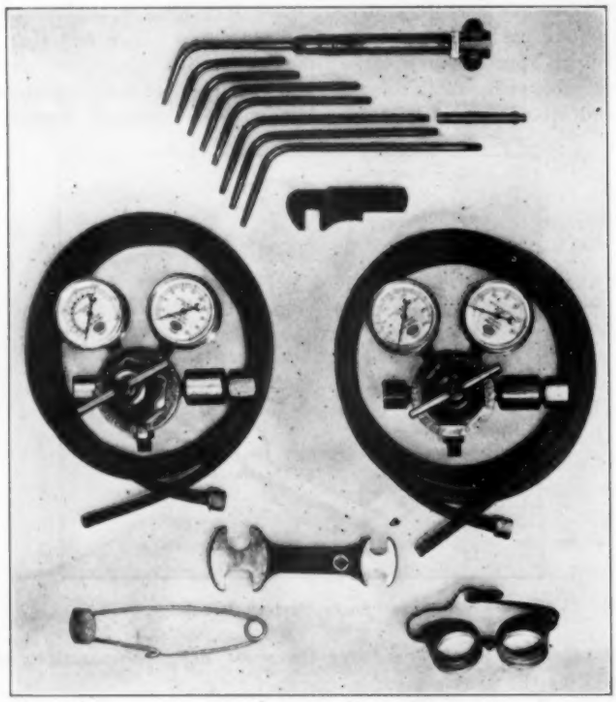
The seat is subject to very slight wear. The spring closes the seat with instead of against the pressure. This enables the seating to be effected by a sealing pressure of several pounds instead of hundreds of pounds, thus eliminating damage to or splitting of the seat. All parts fit or screw into place. No bolts, pins or set screws to manipulate. The "Super Master" also eliminates the danger of freezing even in extremely low temperatures.

The "Super Master" Regulator is the product of The Alexander Milburn Company, 1416-1428 West Baltimore Street, Baltimore, Md.

AIR REDUCTION SALES COMPANY OFFERS NEW WELDING OUTFIT

The Air Reduction Sales Company, 342 Madison Ave., New York, has developed and placed on the market through its district sales offices and distributors, a new low-price welding torch for thin metal welding, known as Style 8900. The new torch, identical in design with the Style 8800 Airco-Davis-Bournonville torch, is somewhat smaller and lighter. Though small and light, it covers the broad range from 1/32-inch sheet steel to 1-inch steel plate—a range well within the requirements of most welding operations, including the joining of steam, water and gas pipes.

The tips made of seamless copper tubing, tapered and bent to the welding angle of 67½ degrees, are threaded at the rear for



Airco Welding Outfit, Number 89.

connection to the mixer head. The threaded end, faced flat, makes up against a seat several inches from the welding zone, assuring a gas-tight joint not likely to be affected by the heat.

Oxygen and acetylene, conveyed from the needle valves through the handle in seamless brass tubes, silver-soldered front and rear, unite in the mixer, which, secured to the handle of an annular nut, is readily disconnected. The No. 1 mixer supplies tips Nos. 1 to 5, inclusive; or with both Nos. 1 and 2 mixer heads the torch can be used with any tip from No. 1 to No. 8 inclusive. The mixing efficiency is high, giving a ratio of about 1.01 volume oxygen to 1 acetylen.

The torch, fitted with standard hose connections for ⅜-inch inside diameter hose, and compact, quick-opening and closing needle valves, weighs 14 ounces with the No. 1 tip, and measures 14 inches long over all. Tested and approved by the Underwriters' Laboratories, it carries the Laboratories' approval plate on the handle, in itself assurance of safe construction. The effort has been to make in every way a dependable torch, having strength, endurance and capacity that shall adapt it to all the lighter welding operations in any field.

The new torch is offered singly, or in combination with the new Airco-Davis-Bournonville pressure regulators in an outfit known as No. 89, comprising Style 8900 torch with tips Nos. 1 to 5, Style 8201 oxygen regulators, Style 8202 acetylene regulator, each with high and low-pressure gauges, two 12½-foot lengths of corrugated ⅜-inch inside diameter hose, wrenches, sparklighter, goggles, and instruction book.

NATIONAL METAL EXPOSITION EXPECTED TO DRAW LARGEST ATTENDANCE

Papers by leading figures in the metal industry which will present new and worth-while ideas developed in the past year, will be read at the technical sessions of the American Society for Steel Treating, held during the National Metal Exposition in Philadelphia, October 8 to 12.

Coincident with the Metal Exposition will be held National Metal Week at which the American Welding Society and Institute of Metals will have their own technical sessions.

Practically all of the exhibition spaces have already been reserved, assuring a full house. The widest publicity has been given to the Exposition, and an attendance of at least 60,000 is expected. National Metal Week in past years has demonstated its value to everyone interested in any way in the metal-working and metal-using industries. Every phase in the manufacturing, treating fabrication and use of every kind of metal will be exhibited and discussed. Judging from the interest displayed at the show at Detroit last fall, the welding section of the exhibition is due to come in for its share of attraction. Thirty or more manufacturers of welding apparatus and supplies will be represented in the section set apart for welding exhibits, affording an excellent opportunity to get acquainted at close range with new equipment and new methods.

The program of the technical sessions of the American Welding Society will be printed in the September issue.

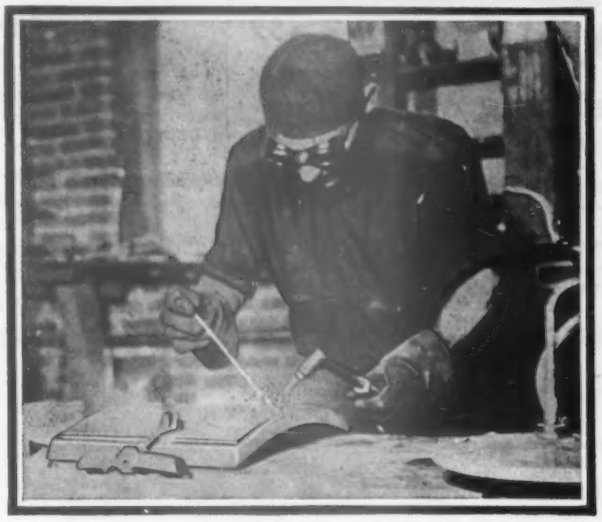
News of the Welding Trade

F. B. Swankhouse, formerly with the H. W. Holmes corporation of Detroit, Mich., has been appointed sales manager of the Electric Arc Cutting and Welding Co., Newark, N. J. This company is planning to extend its agency arrangement, especially in the Middle West and Pacific Coast Regions. The sales arrangement with H. W. Holmes Corporation has been terminated.

Mr. Joseph A. Carmody is representing the Electric Arc Cutting & Welding Co. on the railroads of this country and Canada. Mr. Carmody's headquarters will be at 152 Jelliff Ave., Newark, N. J.

The Burdett Oxygen Company of Texas, a unit of Compressed Industrial Gases, Inc., announces the opening of a new city office at 321 W. 13th Street, Fort Worth, Texas. At this office there will be stocked a complete line of compressed gases, also a complete line of welding and cutting apparatus and supplies. The opening of this sales office will enable the company to improve its service in Fort Worth and surrounding territory.

Robert L. Browne, 1425 Statler Office Building, Boston, Mass., has been appointed district sales representative of the Swift Electric Welder Co., Detroit, Mich., for the state of New York and the New England States.



Welding small parts with TOBIN BRONZE* keeps the shop busy in slack periods

The photograph shows a workman repairing a broken stove part by welding with Tobin Bronze. Not a big job—not a very profitable job, perhaps, from the standpoint of the welding shop.

The point is that these small jobs are often helpful in keeping the shop busy in slack times. Viewed from this angle, there is no such thing as a "small" or "unprofitable" job.

Remember—many of the jobs that come into your shop can be welded with Tobin Bronze in much less time than is required for welding with steel or iron.

With Tobin Bronze it is necessary to bring the base metal to a dull red heat only. Dismantling and preheating are seldom necessary. Tobin Bronze welds are as strong and durable as welds made by any other method, and there is no possibility of burning the material welded.

Tobin Bronze Welding Rods are made solely by The American Brass Company and "TOBIN BRONZE" is stamped in the metal for your guidance and protection.

*Trade Mark Reg. U. S. Pat. Off. and in Canada

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS LIMITED
New Toronto, Ontario

ANACONDA
WELDING RODS

ANACONDA
from mine to consumer

There is a suitable Anaconda Filler Rod for every welding purpose. The principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze	1625°F
Manganese Bronze	1598°F
Brazing Metal	1634°F
Deoxidized Copper	1981°F
Electrolytic Copper	1981°F
A. B. Naval	1625°F
Everdur	1866°F
Ambrac	2102°F

for arc welding

Phosphor Bronze	1922°F
Everdur	1866°F
Ambrac	2102°F
Deoxidized Copper	1981°F

"STANDARD"
Welding Wire
GAS AND ELECTRIC
A grade for each type of work—send for samples.

for sound permanent welds : : lower costs
Our costs are considerably under those of large industrial centers; ours is a one-profit wire sold direct to user from our own mills exclusively devoted to making of welding wire from raw material to finished product—hence our extremely low prices for wire that is definitely superior. Adopted exclusively by many large users.
Prices on request.
Standard Steel & Wire Co., Greensburg, Pa. (Mills at Bolivar, Pa.)

HARRISBURG SEAMLESS STEEL CYLYNDERS

DR. H. E. STÜRCKE'S "OVERFLOW" TEST JACKET

Stainless Iron and Steel Forgings, Tubes, etc.
CHARLES L. GULICK, 110 E. 42d St., New York.

The Pittsburgh newspapers have printed items commending Mr. John T. Butler, manager of the Burdett Oxygen and Hydrogen Co., at Pittsburgh, for his efficient handling of the requirements of the contestants at the National Balloon Race, delivering 600,000 feet of hydrogen gas on Bettis Field ahead of schedule, in spite of unprecedented traffic congestion. It is said that this is the first time one concern has been able to supply all the big bags.

Union Carbide & Carbon Corp., New York, has entered into an agreement whereby it will acquire all of the common stock of the Acheson Graphite Corp., in exchange for its own shares. It is stated that in management and policies of the Acheson corporation will be little changed but a more aggressive sales policy will be adopted.

A. O. Smith Corp., Milwaukee, is practically doubling the capacity of its pipe shop as a result of receipt of heavy orders for electrically-welded oil and gas line pipe. E. W. Burgess is chief construction engineer.

Vancouver Welding Company, 1155 Pender St. West, Vancouver, B. C., have established a school of oxy-acetylene welding. Night classes are held on three nights a week. This is a practical short course, principally to develop skill in the handling of the torch. Little theoretical instruction is provided.

Lewis Seam-Welding Head
PATENTS PENDING
Fits Any Spot-Welder
Proven by 3 Yrs. Use

Will weld *side seams* or *bottoms* of buckets, pails or tanks at 15 to 25 ft. per minute and make joint water and gas tight.
Change from "Spot-Welder" to "Seam-Welder", or the reverse, made in 5 minutes.
One user has made over 1½ million 3 inch lap joints and then nickel plated the piece. **You can't find the joint.** No change to your spot welder — simply clamp Head to upper horn. Bolt on the proper electrode for either transverse or longitudinal welding. The "drive" is a separate unit and NOT attached to spot welder.
Send at once for Bulletin 129.
WELDING APPLIANCE CO.
2111 West Lake St., CHICAGO

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Counted 8 words to line. Add 6 words for keyed address.

{WE WILL BUY} **Used Electric Arc**
{WE WILL SELL} **Welding Machines**
Send Us Particulars and Inquiries
THE BURDETT OXYGEN CO.,
3300 Lakeside Ave. Cleveland, Ohio

FOR SALE CHEAP
Davis-Bournonville No. 1
Oxygraph Oxy-Acetylene
Cutting Machine
SHEPHERD ENGINEERING COMPANY,
Williamsport, Pa.

One Dollar will increase your earning power by bringing you any one of the following GUARANTEED FLUX FORMULAS—Cast Iron—Brazing—Copper—Nickel—High Speed Steel—Aluminum (sheet and cast). With instructions you can make up your own fluxes fresh. R. N. Robbins, 38 Winans Street, East Orange, N. J.

Electric Welders—All types, new, used. W. Montelius Price Co., Seattle, Wash.

Position Open—Executive position will be open on October first with new Company now being organized to manufacture patented coated arc welding rods. Correspondence invited. First rate opportunity is offered person qualified to help organize, promote and operate in this field. Address Box 156, care of The Welding Engineer.

Wanted—Experienced salesman to act as representative for mill manufacturing welding wire exclusively. Address Box 154, care of The Welding Engineer.

Electric Welders—Several reconditioned General Electric Arc Welding Equipments. Price right for quick sale. American Steel Engineering Company, 3520 Queen Lane, Philadelphia, Penna.

Three Arc Welders Wanted—Who can show more than average ability. One must be experienced in operating automatic arc welder. Work located in Chicago. Address Box 168, care of The Welding Engineer.

Position Wanted—Electric and acetylene welder with seven years experience, general repair work in large steel mills. Desires permanent position in Ohio or Western Pennsylvania. Can furnish A1 references. Address Box 157, care of The Welding Engineer.

Position Wanted—As instructor or welding foreman. Six years' experience in railroad shops, 8½ years as instructor of acetylene welding. Harry Hamilton, 1334 Central St., c/o Del Ray Hotel, Kansas City, Mo.

---*for* Strong welds

Nichrome

TRADE MARK REG. U. S. PAT. OFF

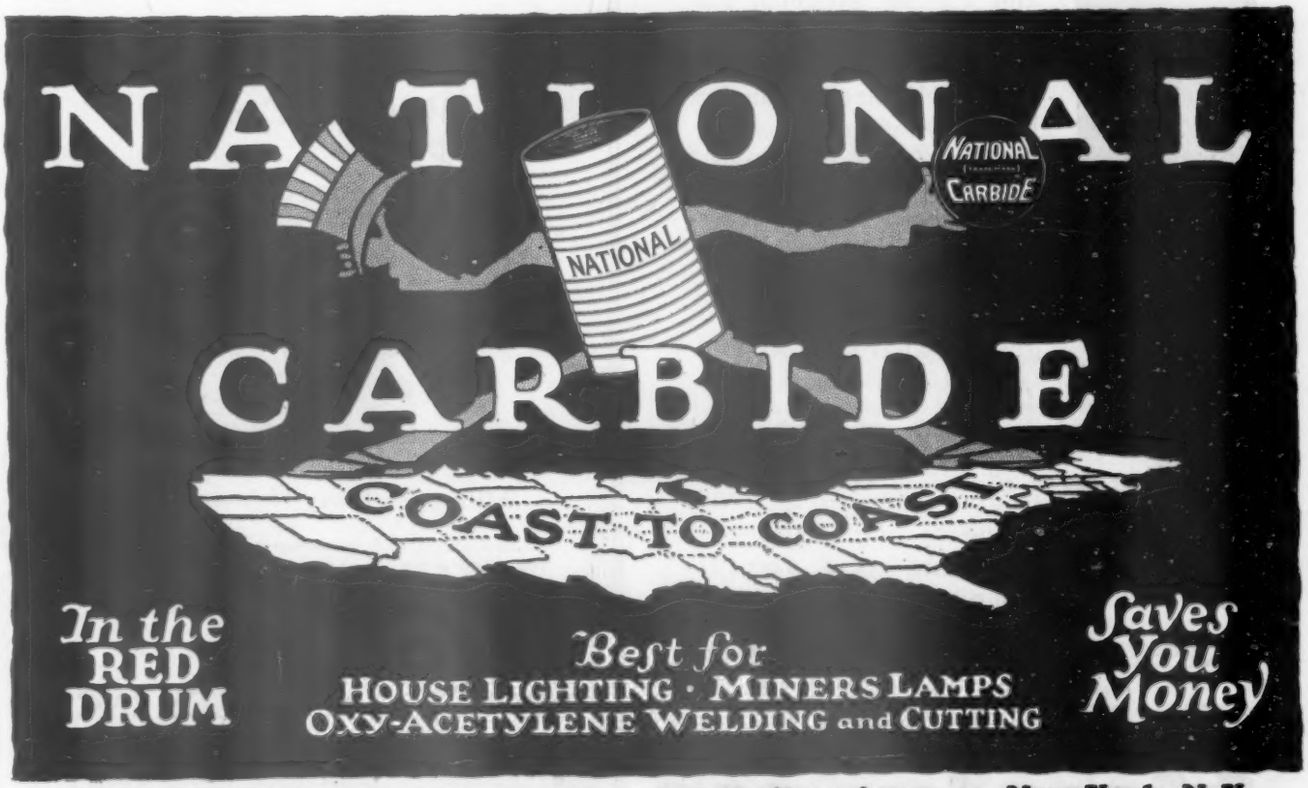
---*the exceptionally strong* Welding Rod

Welds made with "Nichrome" the nickel-chromium alloy, possess exceptional strength. For example, practical tests of welds on mild steel made with "Nichrome" rods, show an ultimate tensile strength as high as 55,000 pounds per square inch. It is interesting to note that the welding operation does not detract from the metal itself.

"Nichrome" welds are readily machinable and may be applied by either the oxy-acetylene or arc welding process. The ease of application and free flowing qualities of "Nichrome" welding rod, together with the fact that it can find wide application, makes its use extremely desirable.

Sample? If you are having difficulty in getting a strong weld, we are sure "Nichrome" will prove satisfactory. *Sample rods will be sent on request.*

DRIVER-HARRIS COMPANY
HARRISON, NEW JERSEY
Chicago - Detroit - Morristown, N.J. - England - France
Alloy Makers since 1899



National Carbide Sales Corporation . 342 Madison Avenue . New York, N. Y.

As Good As Ever --And Better

"Give me cylinders as good as the last ones and I'll be satisfied," is the common expression of acetylene gas manufacturers who are still using Hackney cylinders bought 5 - 10 - 15 - 18 years ago.

For the past 18 years Hackney cylinders have been giving these manufacturers and welding engineers what they wanted —safe, economical handling of acetylene gas.

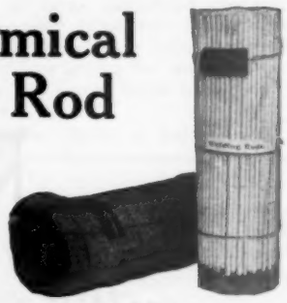
And Hackney continues to give them just as good cylinders and better—as time and cost records will prove.

PRESSED STEEL TANK COMPANY

1125 Continental Bank Bldg., Chicago, Ill.
1301 Vanderbilt Concourse Bldg., New York City
5701 Greenfield Avenue, Milwaukee, Wis.

Hackney
MILWAUKEE

An Economical Welding Rod



Price is not the only factor that determines economy. Uniformity and dependability play a larger part in the cost of making good welds than the price per pound of welding wire.

"Seneca Gas Weld"
"Seneca Electro Weld"

are uniform and dependable because they are made by our own processes from specially selected stock. They are produced as Special Soft, Medium, Hard, Extra Hard, shipped in coils or straight lengths, in Black, Bright, Coppered Finish, Flux Coated.

Your inquiries will receive prompt attention

The Seneca Wire Mfg. Co.
Established 1905
Fostoria **Ohio**

AGENTS WANTED—COMMISSION BASIS

Built for Welders' Comfort

Willson Welding Helmet No. 130

You know what it means to have free breathing and head comfort in a welding helmet! You'll find it in this "Willson." And the glass is Willson-Weld,—last word in protection.

Price Complete, $10.20 each f. o. b.

WILLSON GOGGLES, INC.
READING, PA.

LEGAL NOTICE

Our handshields and helmets are protected by patents and notice is given of prosecution of infringers.

New 1929 Model!

FUZON ARC WELDER

A truly Portable Unit —

GAS ENGINE DRIVEN

No matter where the job is, this welder can be taken to it! New principles of design are incorporated eliminating induction coils, reactors and other troublesome adjuncts. Has but one single control, giving an infinite number of current gradations. Extremely easy to operate.

Write for bulletin.

FUSION WELDING CORPORATION

Welding Equipment and Supply Division of Chicago Steel & Wire Company

Engineers—Manufacturers—Merchants

103rd STREET AND TORRENCE AVENUE, CHICAGO

Saves

time-labor-money

Time! . . . the most valuable thing in industry . . . and the Stoody Portable Grinder *saves it!* This *modern* grinder is adaptable to any purpose for which a grinder is used. Its large, powerful motor will not heat up, even if used continuously on heavy work, yet the shaft and wheel that the operator holds are so light that he may touch the work as lightly or heavily as he pleases.

For regular work, unusual work, steady work or intermittent work, the Stoody Portable Grinder offers the welder, manufacturer and machinist an entirely new conception of time and labor-saving convenience.

Drop us a line and let us tell you all about this *newer, better* way.

Address Dept. C,

STOODY COMPANY

WELDING RODS - ALLOY STEELS - EQUIPMENT

WHITTIER — CALIFORNIA

K-G Apparatus MUST Deliver

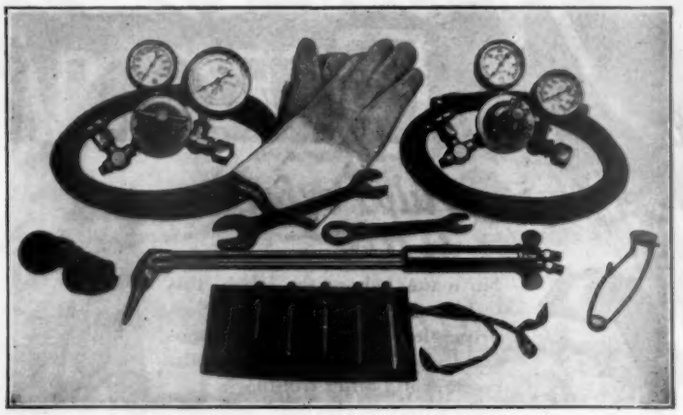
There are three requirements that every piece of K-G Apparatus must meet:

It must eliminate waste of gas and time;

It must be built for hard service;

It must be perfectly safe under all operating conditions.

This high standard means that you can absolutely depend upon K-G equipment going through with the job set for it. What is more, K-G torches have a high rating for real value because they have such long welding life. Because of the simplicity of design and careful selection of materials, they are practically everlasting. You don't know what good strong torch construction can do to keep down your welding costs until you have given K-G a thorough trial.



A Standard K-G Welding Unit—Every Part Dependable

The New K-G Regulator

The new K-G Regulator is bound to be as popular as the K-G torches, because they are solidly and properly built, embodying new and original improvements in the mechanism which eliminates the defects experienced with other regulators.

K-G WELDING & CUTTING CO., INC.
515 W. 29th St. **New York City**

Everything in
FRICTION GAS LITERS and RENEWALS

At Lowest Prices
Highest Grade
Guaranteed

Shootalite, Round File, Movable File, Pyro, etc. The "flint" on the spark tips and renewals is specially treated. Guaranteed to keep for years without powdering.

Use friction liters for all kinds of gas, gasoline, canned heat, etc. Saves lives and property, and eliminates the match nuisance in homes and shops.

We also handle all styles of pocket and desk cigar liters and accessories, at low prices.

Distributors and dealers wanted everywhere

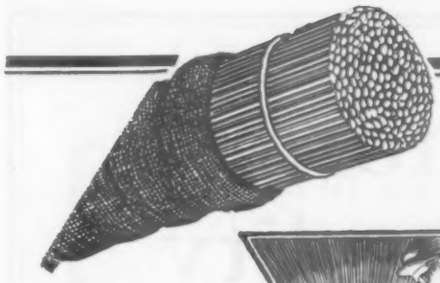
MATCHLESS UTILITIES CO.
690 Eighth Ave. **New York, N. Y.**

American Welding Society
33 West 39th Street
New York, N. Y.

WHAT IS IT DOING?

WHO ARE ITS MEMBERS?

The Secretary has a copy of the Membership Directory for you. Write for it.



WISSCO Welding Rods

WHEN you write "WISSCO" into your welding rod specifications, you *insure* satisfaction . . . for you get not only a superior welding rod, but the aid and advice of an Engineering and Metallurgical Department that has studied welding in all its phases.

WISSCO Welding Rods are pre-tested and graded to meet the particular needs of gas and electric welders.

If you have a welding problem, put it up to WISSCO Engineers. They will find a solution.

WICKWIRE SPENCER
STEEL COMPANY
41 EAST 42ND ST.
NEW YORK CITY

WICKWIRE SPENCER STEEL CO

WISSCO WELDING RODS

High Tensile

WHERE high tensile strength in welds is required use Norweld Rods with the Oxy-acetylene Process. Soft copper coated rods for Wrought Iron, Steel, Tanks, Boiler Plates, Sheets, Angles or Flues. Supplied in standard 36" lengths or coils.

A Rod for Every Job

In Gas or Electric Welding

Large stocks of welding rods—both gas and electric—are carried in our Chicago plant for immediate shipment.

WILSON COLORTIPT	HIGH MANGANESE
NORWELD SPECIAL	NICKELWELD
NORWELD	ELECWELD SPECIAL
CASTWELD	ELECWELD
BRONZEWELD	STEELWELD
HICARWELD	VANADWELD

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Steel — Monel Metal — Nickel — Brass — Copper — Copperweld — Nickel Silver Nickel Zinc — Phosphor Bronze

SEND FOR THE WELDER'S GUIDE

Steel Sales Corp., 129 S. Jefferson St., Chicago

Gentlemen: Please send me the Welder's Guide, a practical book on welding.

We do— ☐ Elec. ☐ A. C. ☐ D. C. ☐ Acetylene welding

Firm.....

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Welded Steel Gas Blower manufactured by B. F. Sturtevant Co., Boston, Mass.

Before welded construction was developed, gas blowers of this type were made either of cast iron or of riveted steel. An example of the cast-iron type is shown in this picture, to the right of the welded blower. The saving of the welded over the riveted construction is approximately 25%—and more where the design is not standard and pattern-making is involved.

Better welding —for less money

PAGE Welding Wire is preferred by large users of welding wire because it enables them to do better welding at less cost.

While the cost of welding wire is only a small part of the total cost, it plays the most important part of a good welding job. Naturally, then, the better the welding wire —the better the welding job—the fewer the rejections—and the lower the cost.

All PAGE Welding Wire and Electrodes are processed to assure perfect performance and every run is shop-tested under actual job conditions, flame tested and then stamped for quick identification. That's why PAGE Welding Wire is uniformly "right." If you are interested in better welding at less cost, it will pay you to investigate PAGE Welding Wire. There is a grade for every type of welding operation—let us recommend the grade *you* need.

Your name and address bring a free sample. Make your own convincing test.

PAGE STEEL *and* WIRE COMPANY
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District Offices:
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of the American Chain Company, *Incorporated*
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PAGE-ARMCO
PLANE TESTED PROCESSED SHOP TESTED
Welding Wire *and* Electrodes

Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

COMMERCIAL SERVICE
Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30-in. size - -	125 cu. ft. cap.
12x36-in. size - -	225 cu. ft. cap.
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Commercial Acetylene Supply Company, Inc.

General Office: 71 Broadway
New York City

BRANCHES:

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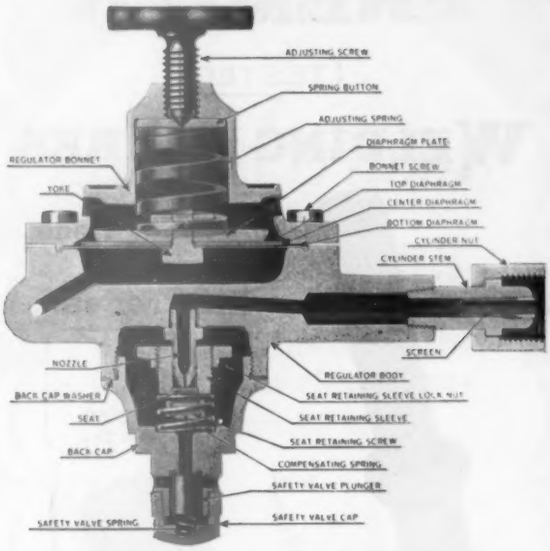
You Can Do It Better With TORCHWELD

Torchweld Regulator Safety Features

Torchweld safety relief valve protects diaphragms, seats and gauges because it automatically relieves any excessive oxygen pressure which may enter the regulator.

Torchweld safety relief valves do not contain a disk to be replaced but are strictly automatic and always ready to perform.

Torchweld regulators are rugged in construction, accurate in performance and always safe to operate.



"Built to Stand the Abuse of Constant Use"

TORCHWELD EQUIPMENT COMPANY
224 N. Carpenter St. CHICAGO

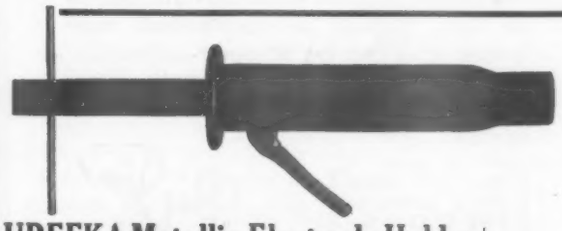
After all—there is no better machine!

Cleaner welds mean better jobs and Better Jobs mean more jobs.

Biax guarantees its shaft to do your work for a year.

Write today for full information and catalogue E.

BIAX FLEXIBLE SHAFT COMPANY
20 EAST 17th STREET NEW YORK, N. Y.
Machinists Tool & Supply Co., Los Angeles, Cal.



$4.50

UREEKA Metallic Electrode Holder

Permits the holding of electrode with tremendous pressure, but requires only very slight pressure to release. Perfect electrical contact between electrode and holder, with elimination of current losses and overheating. For 1/8" to 1/4" diameter electrodes.

GREAT STRENGTH, LIGHT WEIGHT, AMPLE CURRENT CAPACITY. NO SPRINGS.
Saves time, current, rod and worry. Try it.

$10

VULCAN Carbon Electrode Holder
for all heavy duty carbon arc welding

Positively will not overheat. Light weight. Easy to manipulate. 200, 400 and 600 ampere sizes for 1/2", 3/4" and 1" diameter Electrode.

DISTRIBUTORS WANTED

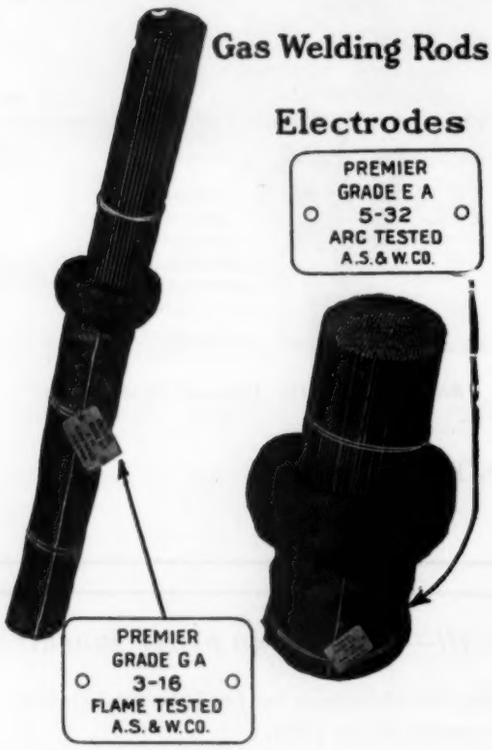
The Fibre-Metal Products Co.
Designers and Manufacturers since 1914 of Bower's Welding Helmets and Hand Shields
CHESTER, PENNA.

American Steel & Wire Company's

PREMIER

TESTED

WELDING WIRES



Gas Welding Rods

Electrodes

PREMIER Welding Wire flows freely, giving perfect fusion, thorough penetration and the desired finish. The uniform quality of Premier Welding Wire insures a deposit of metal in the weld free from foreign inclusions and possessing maximum strength. Before shipment, every bundle is electrically tested and manually welded. Permanently satisfactory welds and a saving of gas, electricity and the welder's time are thereby assured.

For a dependable welding job, use an appropriate grade of Premier Welding Wire. Send for booklet giving full information and specifications.

American Steel & Wire Co.

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CINCINNATI.....Union Trust Bldg.	BALTIMORE.....32 So. Charles St.
MINNEAPOLIS—ST. PAUL.....	BUFFALO.....670 Ellicott St.
....Merchants Nat'l Bank Bldg., St. Paul	WILKES-BARRE.....Miners Bank Bldg.
ST. LOUIS.....506 Olive St.	DALLAS.....Praetorian Bldg.
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OKLAHOMA CITY.First Nat'l Bank Bldg.	SALT LAKE CITY....Walker Bank Bldg.
BIRMINGHAM.....Brown-Marx Bldg.	*SAN FRANCISCO.....Russ Bldg.
MEMPHIS.Union and Planters Bank Bldg.	*LOS ANGELES....2087 E. Slauson Ave.
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PITTSBURGH.....Frick Bldg.	*SEATTLE.....4th Ave. So. & Conn. St.
PHILADELPHIA.....Widener Bldg.	*United States Steel Products Company

Now in full production with

"KORO"

(Patent applied for)

ELECTRODES

The improved production facilities in our new plant enable us to furnish KORO electrodes in any volume at prices which are distinctly attractive. The quality of the electrode is uniformly good, and the KORO processing and coating give it the rapid working quality which is so necessary in production work as well as repair work.

Send a trial order for some KORO wire from the new plant.

KORO CORPORATION

WAUKEGAN, ILLINOIS

A complete line of gas and electric welding wire.

Big Jim (Master Welder)

says:

If you want to *boost* your business, buy FRE-FLO welding rods. They're free from sand, have no burrs or fins, packed in convenient size boxes, and can be shipped promptly from stock. Best of all though, they save you money because they're true to size.

[Shall we send you a sample of FRE-FLO to try in your shop?]

Big Jim (MASTER WELDER)

FRE-FLO Rods are sold only through distributors. A few desirable territories are still open. Correspondence from distributors is invited.

The Atlas Foundry Company

Department B

W. 69th & W. & L. E. Ry. Cleveland, O.

Don't Use Costly Gas and Time Getting a Neutral Flame

The WELDIT GASAVER

Saves That Useless Cost

ONE flame adjustment lasts all day. Torch is hung on hook when not in use, and no gas is burned. A pass of the torch tip over the pilot light gives you the neutral flame you had before. Savings as high as 40% have been reported. It's a safety device, too. An automatic check valve keeps flash-backs from reaching hose or regulators. The Gasaver can be used with any type of apparatus.

Approved by
National Board of Underwriters
Licensed Under Basic Patents

WELD IT WITH WELDIT EQUIPMENT AND SUPPLIES

Welding Torches	Cast Iron Rods
Cutting Torches	Welding Hose
Regulators	Brazing Wire
Lead Burning Equipment	Fluxes & Solders
Welding Wire	Safety Gloves
Welding Goggles	Service

WELDIT ACETYLENE CO.

634 Bagley Ave. DETROIT, MICH.

MODEL "O"

has been designed to give the welder a maximum of comfort and protection embodied in the extreme lightness of weight, proper ventilation and the absolute exclusion of all outside light.

Model "O" Handshield

MODEL "O"

is made throughout of special vulcanized fibre of exceptional strength and wearing qualities. This shield carries the CESCO indorsement; your assurance that the degree of quality and workmanship is of the highest.

PRICE

Complete with ESSENTIALITE Lens
$5.00 *each.*

Manufactured by

Chicago Eye Shield Company
2300 Warren Ave., Chicago, Ill.

HANDY & HARMAN
HANDY SOLDERS
QUALITY SERVICE

More Certainty in Soldering

can be insured by the adoption of the proper formula of

Silver Solder

for use on any metal having melting point above (1400°F)

Characteristics

1. Low melting point
2. Free flowing properties
3. Affinity for other metals
4. High tensile strength
5. Ductility—malleability
6. Resistance to shocks
7. Ability to withstand vibration
8. Immunity to corrosion
9. High electrical conductivity
10. Small quantity necessary

Forms and Formulas

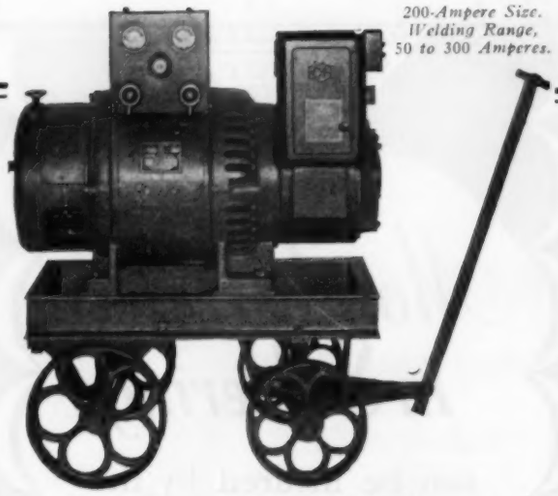
Handy silver solders are furnished in sheets, strips, wire and filings—in twelve standardized formulas, ranging from 10% to 80% silver. Send parts you solder in quantities to our Bridgeport, Conn., plant and write fully. We will make all necessary experiments and tests, without expense to you—and will make our recommendations promptly.

Send for our silver solder book.

Handy & Harman

EXECUTIVE OFFICES
57 William Street,
New York

PLANTS
Bridgeport, Conn. -:- Providence, R. I.
Fulton & Gold Sts., N. Y. City



200-Ampere Size. Welding Range, 50 to 300 Amperes.

You Can Weld All Day at Rated Capacity with the

HANSEN
ARC WELDER

Sturdiness and durability are built into this generator at no extra cost. This is possible in the HANSEN because we do not have to provide an expensive external stabilizer. The stabilizing is accomplished entirely by the generator windings, an exclusive HANSEN feature. No other machine will compare with it for continuous welding.

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See the safe distance of hand from flame

SAFE!
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The finest torch lighting device ever made. Try it.

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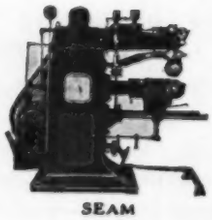
For Production Electric Welding Machines



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Gibb Welding Machines Company
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Welding Rods for Every Purpose

WILSON	WILLIAMS
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ELECTRIC ARC WELDING WIRE	WELDING WIRE

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High-Grade
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Send for samples of the new Weldflo wire

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Look at it any way you like —
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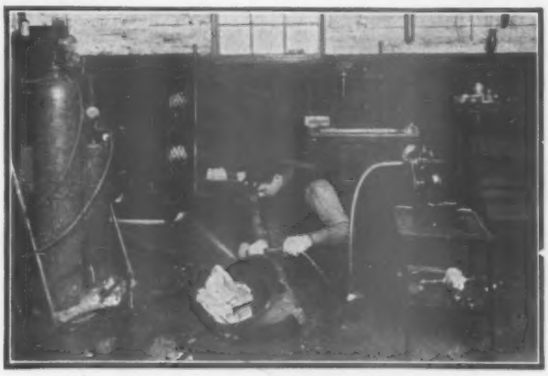

Grinding down a Welded Spot on a casting.
A very common use for H-5 equipment.

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It will pay you well to investigate how much more adequately HASKINS Flexible Shaft Equipment will serve you than your present tool machinery. Here is equipment which provides **hand-tool flexibility coupled with power.** It is light in weight and portable; it permits the tool to be carried to the job—to be used with ease in hard-to-reach places. And the tool is driven electrically, through a flexible shaft, by a high-powered motor with more than ample driving force for the heavy jobs.

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SPECIAL FOR ELECTRIC WELDERS

Crown All-Metal Filler is the only compound that will make an electric weld on cast iron absolutely watertight. It penetrates through the smallest pin-hole where it is possible for water to leak out, and the filler will rust, which is necessary for a permanent repair.

Oldest Exclusive Makers of Aluminum Solders

TRADE MARK

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Crown Aluminum Solder (hard) has been tested by the Bureau of Standards, Washington, D. C., and shown to possess tensile strength of 14,500 pounds to the square inch. Not only is Crown the strongest made, but the easiest to handle and apply, and the saving of labor makes Crown a necessity to every welder.

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Crown Iron Metallic Filler is the incomparable metal for filling scored cylinders. The special Crown acid is supplied free.

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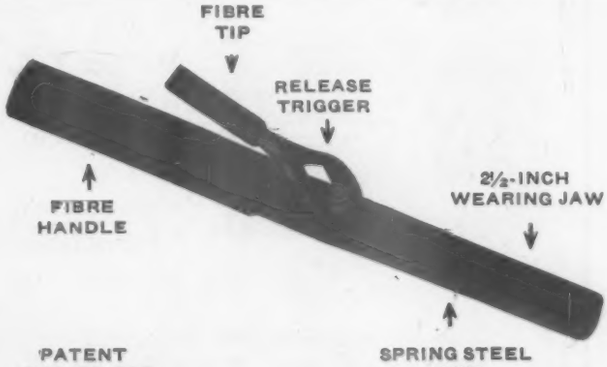
Crown Aluminum Solder Co. 881 E. 134th Street New York City



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Most Simple—Most Efficient—Metallic Electrode Holder Yet Developed.

There are no springs to lose tension for the grip is positive through both jaws. Careful construction has reduced heating to a minimum, while the operator is at the same time fully protected from shocks. It is simple to quickly insert and release the electrodes, which can be used with very small amount of waste. Its construction permits the removal or replacement of the holder cable with only the aid of a screw driver—it is not necessary to use soldering. All of these exclusive features make the Almanc Metallic Electrode Holder a wise buy. *Distributors Wanted*

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All Equipment Fully Guaranteed.
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for the production of hydrogen

Knowles Patented Cells are safe, simple, easy to install, automatic, low in first cost and maintenance, and in addition to flexibility of operation have the advantage of producing also a quantity of pure oxygen equal to 50 per cent of the hydrogen volume.

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Dixon's Graphite Rods and Plates for Welding

Made in all diameters, lengths and sizes.

Small diameter rods are sold in 4, 6 and 8 inch lengths, the shorter the rod the less breakage in shipping.

Also Dixon's Graphite Welding Putty. In 5 and 10 lb. cans.

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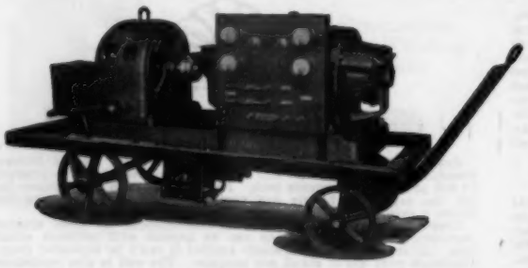
1827— ONE HUNDREDTH ANNIVERSARY —1927



More Welds at lower cost

Burke Variable Voltage Welder

In addition to the single operator type of welder we build a two-operator machine which is distinctively a Burke development.

Either operator can regulate for his own requirements without affecting the other and may use any proportion of the capacity of the welder as long as their total demands are not greater than the rated output of the machine.

The results are self evident—greater production, flexibility and lower cost per weld.

Bulletin No. 133 gives complete description and superior features. *Write for it.*

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A complete and thorough course for the beginner or advanced training for the man who wants to extend his knowledge. Our instructors are men with years of practical experience assuring you of complete instruction in all applications of oxy-acetylene and electric welding. Actual, practical work in simple, easy-to-understand lessons. We teach iron, steel, brass, bronze, aluminum and all other metals. Our pipe welding department teaches pipe installations and blue prints.

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SHRADER
PORTABLE ARC WELDER

SPECIFICATIONS

GENERATOR: 300 amperes continuous; 400 amperes intermittent; ball bearing, 950 R.P.M.; extra heavy duty type.

POWER TAKE-OFF: Specially designed for welding service. Connected directly in drive line, provided with shifting lever for driving either car or generator.

GOVERNOR: Patented electric control. Does not affect car speed when generator is idle. Prevents surging of motor. Provides perfect inherent ampere control. Provides extremely elastic arc for all possible welding conditions.

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A Grinnell Glove

Made from good heat resisting Buckskin. Has a Special Woven Fabric Palm and Thumb lining with six-inch cuff to protect the arms. Used extensively by General Electric Co. at Pittsfield, Mass., and many other large firms having major welding operations.

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meets two vital welding requirements

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Our product is not a domestic imitation of Swedish Iron. It is not manufactured in this country. We import it direct from the mill in Sweden. Its fine working qualities are largely due to manufacturing processes which yield an iron practically free from impurities.

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The Ideal Glove for Electric and Acetylene Welders is made from Sheep Skin, which has been Subjected to an Asbestos Treatment and which makes it both heat resisting and fireproof.

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The Ideal Apron for Welders is made of leather which has been especially treated to stand the heat, and at the same time be very flexible and durable.

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A New Mixing Principle

a regulator that accurately controls gases and the greatest working range ever covered by one torch are exclusive IMPERIAL features.

The Imperial Automatic Acetylene Generator

produces an absolutely pure acetylene gas at a **saving of from 2 to 4 cents** on every foot you use. Approved by the Underwriters Laboratories.

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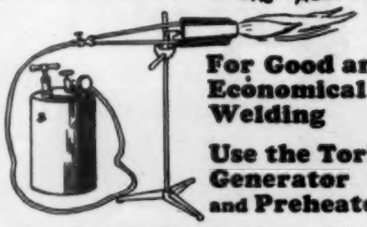

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The Same Torch and The Same Tips For Both Operations

Here's another Milburn time, labor and money saver. One torch and one set of tips for cutting and welding. A quarter turn of the tip makes this cutting torch a welding torch and vice versa. This remarkable new torch, known as the Type T1, saves expense of one Torch: saves expense of extra tips; saves operators' time and saves gases usually lost when changing torches. In addition, it employs Milburn principles which have caused users of Milburn Torches to report operating savings of 20% and upwards. Cuts metal up to 10" thick and performs all welding within range of the process. Get full details of this remarkable Milburn invention.

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"ANTI-BORAX"
Oxy-Acetylene Fluxes
are made for every metal and have EXCEPTIONAL merit.

BRAZ-CAST FLUX
For bronze welding of Cast Iron.

We also make the popular "E-Z" Welding Compound for forge welding.
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Money refunded on return of goods, if not what you want.
WRITE FOR DEALERS' PRICES
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JOHNSON'S MAGIC SOLDER

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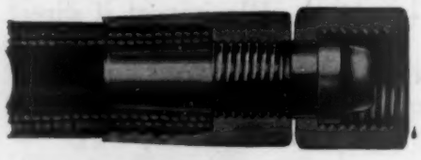

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COULD YOUR PROBLEM BE ANSWERED by the SPOT WELDING of DISSIMILAR METALS?

THE success of the use of Elkonite Welding Electrodes in spot welding dissimilar metals and alloys has brought it to the attention of welding engineers the country over.

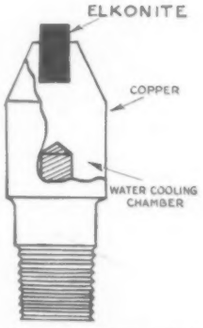


Fig. 1. Water cooled spot welding electrode showing Elkonite Insert. (Courtesy General Electric Co.)

The variable electrical and heat resistance of the different grades of Elkonite Welding Electrodes, plus their ability to hold their shape without mushrooming under red heat, heavy pressures and high currents are properties of immense value.

For this variable, relatively high resistance Elkonite as one electrode, with low resistance Elkonite or copper as the other, gives the balance necessary for even heating to welding temperature of metals of unequal heat and electrical conductivity, such as, for instance, copper with galvanized iron, or with nichrome.

METALS	ALUMINUM	ASCOLOY	BRASS	COPPER	GALVANIZED IRON	IRON	LEAD	MONEL	NICKEL	NICHROME	TIN PLATE	ZINC
ALUMINUM	•											
ASCOLOY		•		•	•	•		•	•	•	•	
BRASS			•	•	•	•		•	•	•	•	
COPPER		•	•	•	•	•		•	•	•	•	
GALVANIZED IRON		•	•	•	•	•		•	•	•	•	
IRON		•	•	•	•	•		•	•	•	•	
LEAD							•					
MONEL		•	•	•	•	•		•	•	•	•	
NICKEL		•	•	•	•	•		•	•	•	•	
NICHROME		•	•	•	•	•		•	•	•	•	
TIN PLATE		•	•	•	•	•		•	•	•	•	
ZINC												•

Fig. 2. Combinations of metals successfully welded with Elkonite. (Courtesy General Electric Co.)

This is but one phase of the contribution that Elkonite has made to resistance welding. In flash, cross-wire, projection welding, electrical upsetting of rivets, as well as in spot welding non-ferrous and heavy gauge ferrous metals Elkonite, by eliminating lost time and production due to constant redressing, and shrinkage loss, is showing new economies and production possibilities in many industries.

Our engineering staff will gladly co-operate in any resistance welding problem.

142 & 144

ELKON WORKS Inc.

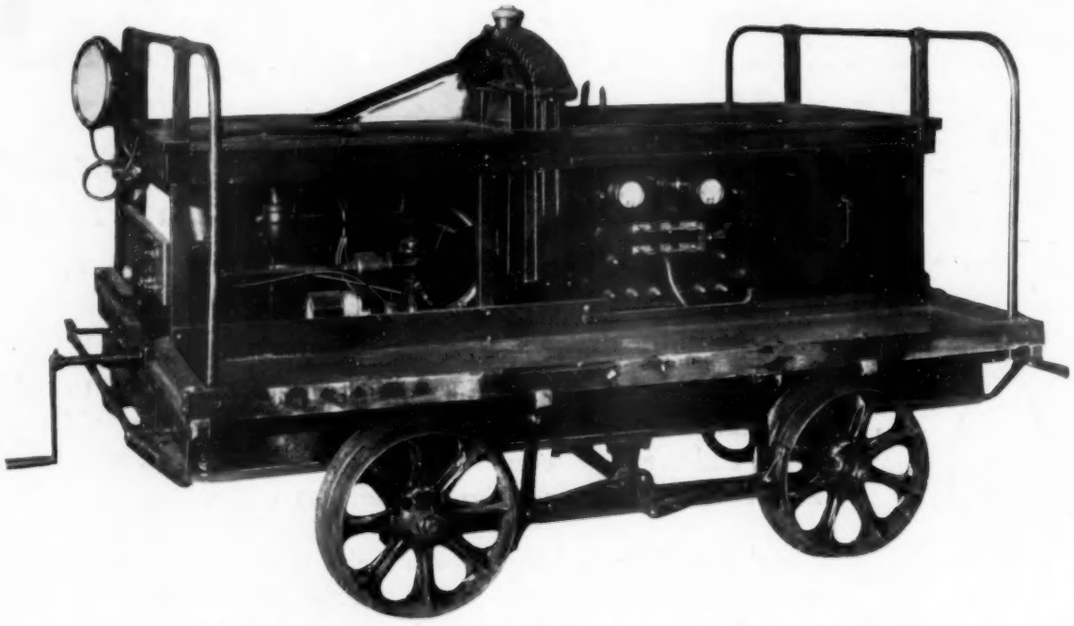
Subsidiary of P. R. Mallory & Co. Inc.

Weehawken, N. J.

Exclusive licensees under General Electric Co. patents dated May 28, 1925 and Sept. 1, 1925. Other patents pending to Elkon Works.

DUALARC *built the First*

SELF-PROPELLED RAILWAY GAS ENGINE WELDER



Model U-200, For Use by Steam and Electric Lines

Exhibited in the fall of 1925, this self-propelled car was the first ever put on the market, and is complete in every detail.

The entire outfit consists of a regulation "Dualarc" Gas Engine Welding Set mounted on a standard track car, equipped with a ball-bearing motor for driving in either direction. An interlocked control is used to effect the acceleration and for welding, in addition to the welding control provided for the electrical system.

The car is equipped with lights operated from the generator, and provision is also made for drills, grinders, electric hammers, chipping and caulking tools.

The set is furnished with hand brakes on all four wheels and is designed for operation in either direction up to 25 miles an hour light or 15 miles an hour hauling one trailer.

Air compressor can be provided if desired. ***Choice of turn-table derailer or jack-up derailer without extra charge.***

Guarantee—The apparatus is guaranteed throughout to be complete and without electrical or mechanical defects.

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